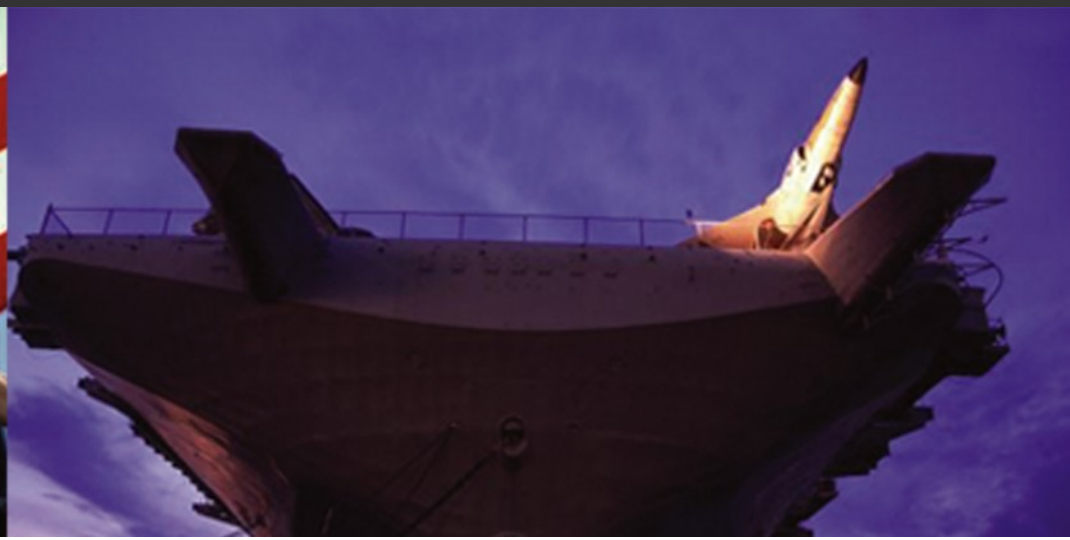
Predicted Line of Sight Applications at CSC

Eddie Landry

April 18, 2004



EXPERIENCE. RESULTS.

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CSC
EXPERIENCE. RESULTS.

PLOS Applications

- Force on Force Simulations
- 2002 Winter Olympics Support
- Distributed Line Of Sight Tool (DLOST)
- Intelligent Range Monitoring System (IRAMS)
- Proto-Command

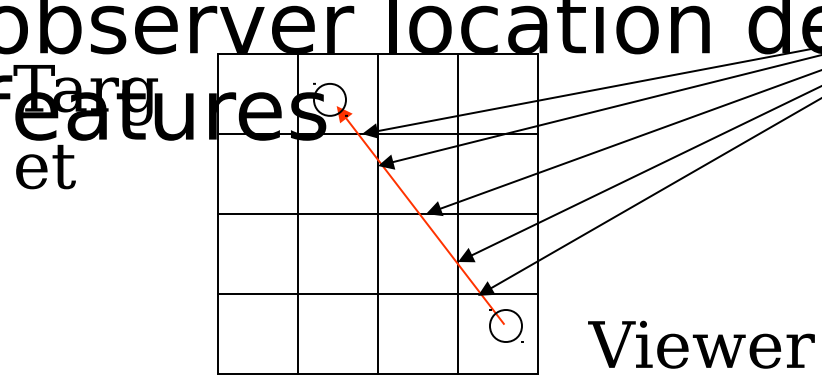
EXPERIENCE. RESULTS.

Force on Force Simulations

- Janus
- CASTFOREM
- ProtoForces

ProtoForces LOS Algorithm

- Gridded terrain database
- Check LOS at each edge by interpolating between two grid points
- The observer has visibility from observer location despite associated features

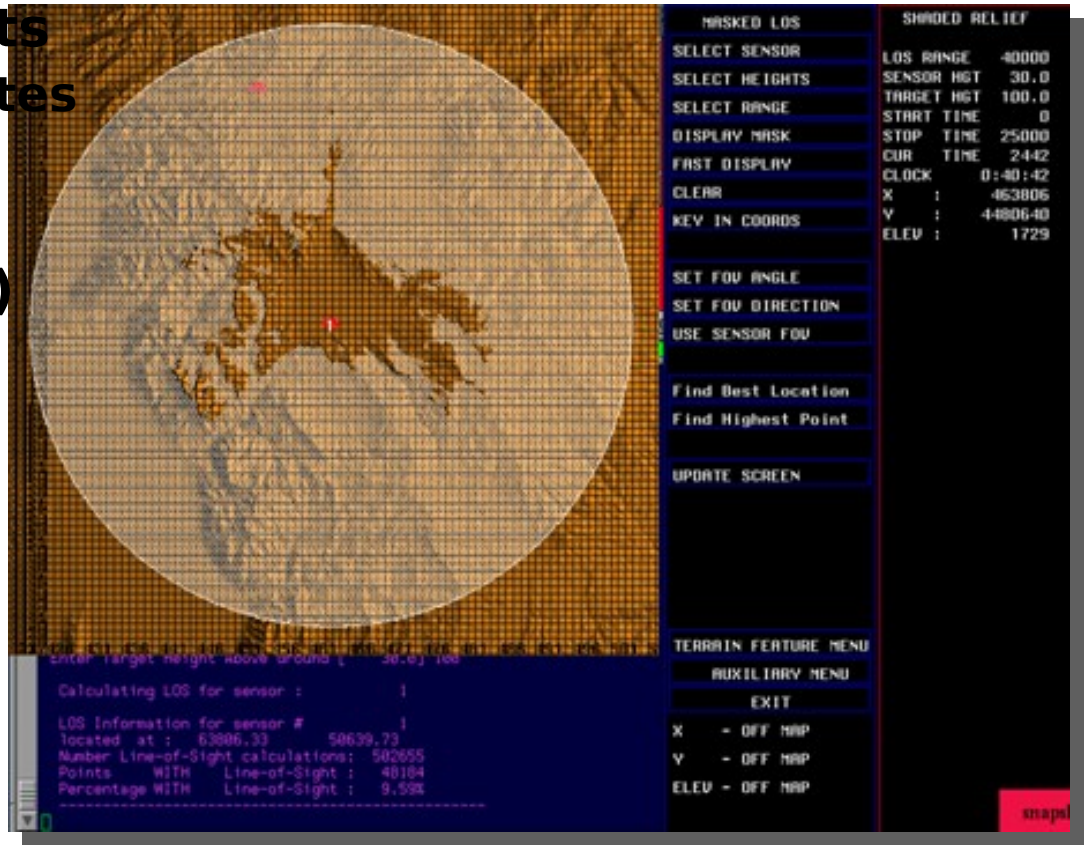


EXPERIENCE. RESULTS.

Dynamic Terrain Analysis Tool

Inter Visibility Using Digital Terrain Data

- **User Friendly Inputs**
  - Sensor Coordinates
  - Sensor Height
  - Target Altitude
- **Line Of Sight (LOS) Calculations**
  - Target Unmask Distance
  - Coverage Map
- **Terrain Data Types**
  - DTED
  - DFAD
  - ADRG



EXPERIENCE. RESULTS.

2002 Winter Olympics Support

- Predicted LOS for RADAR deployment sites
- Deploying Sentinel RADAR for protection from terrorist airborne threats

Sentinel stands guard at Winter Olympics in Salt Lake City

Two radars assigned full time during games

By BOB HUNT
For the Rocket

Redstone Arsenal played a key role in safeguarding the recently completed Winter Olympics in Salt Lake City.

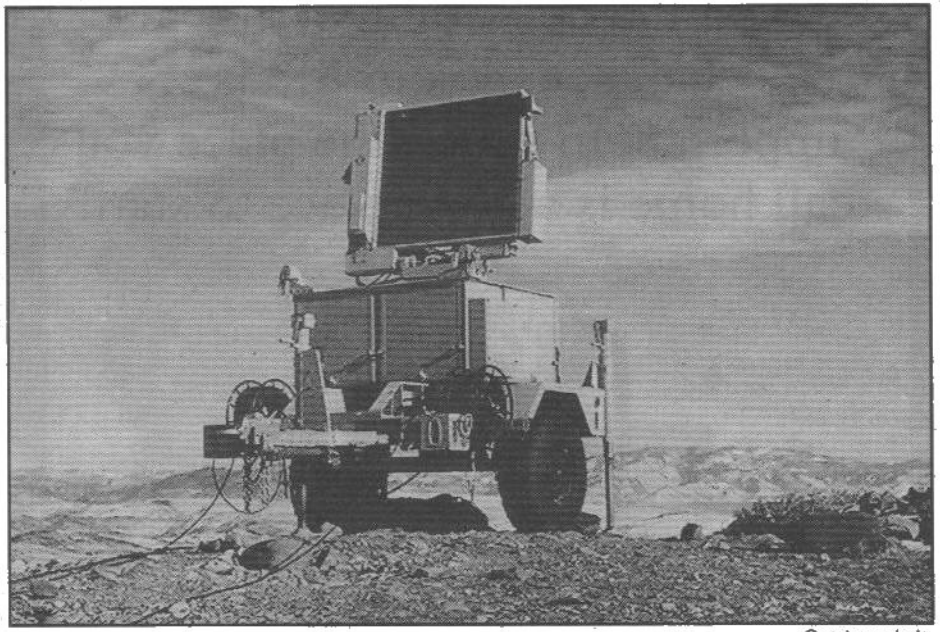
Two Army Sentinel radars, managed by the Short Range Air Defense Project Office, were assigned to full-time duty during the games. The Sentinel is a three-dimensional radar used to automatically detect, track, classify, identify and report airborne threats.

"We have worked with the FAA (Federal Aviation Administration) for several years now," said Sentinel product manager Lt. Col. David Cook, "to provide threat protection using a variety of FAA and DOD radars.

"FAA radars can view up and out great distances," Cook said, "but only Sentinel can complete the radar image by detecting low-flying threats, especially in mountain valleys like those around Salt Lake City." This is the second time Sentinel has served at an Olympics. Sentinel was also employed at the 1996 Atlanta games where it detected 48 aircraft penetrating restricted airspace. At the Salt Lake games, Sentinel radars detected more than 20 instances of low-flying aircraft, usually private airplanes, entering restricted airspace.

"Black Hawk helicopters were then dispatched to intercept and escort intruders away," Cook said.

The Sentinel radars used at the Salt Lake games belong to and were operated by personnel with the 1/44 Air Defense Artillery Unit, Fort Hood, Texas. The SHORAD Project Office provided a spare parts package and arranged for contractor field support.



Courtesy photo

ON DUTY— A Sentinel radar guards the Salt Lake City Winter Olympics.

CSC
EXPERIENCE. RESULTS.

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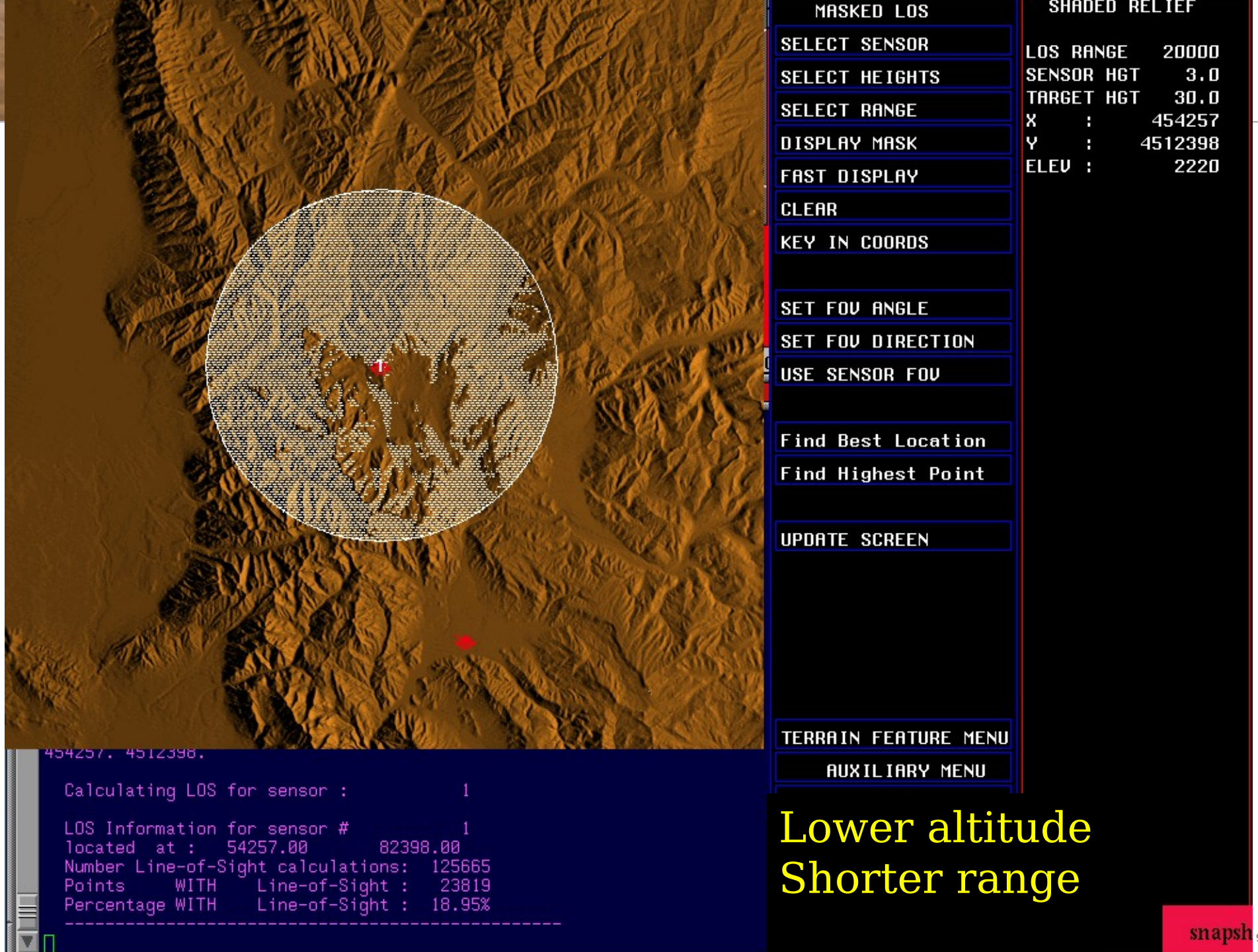
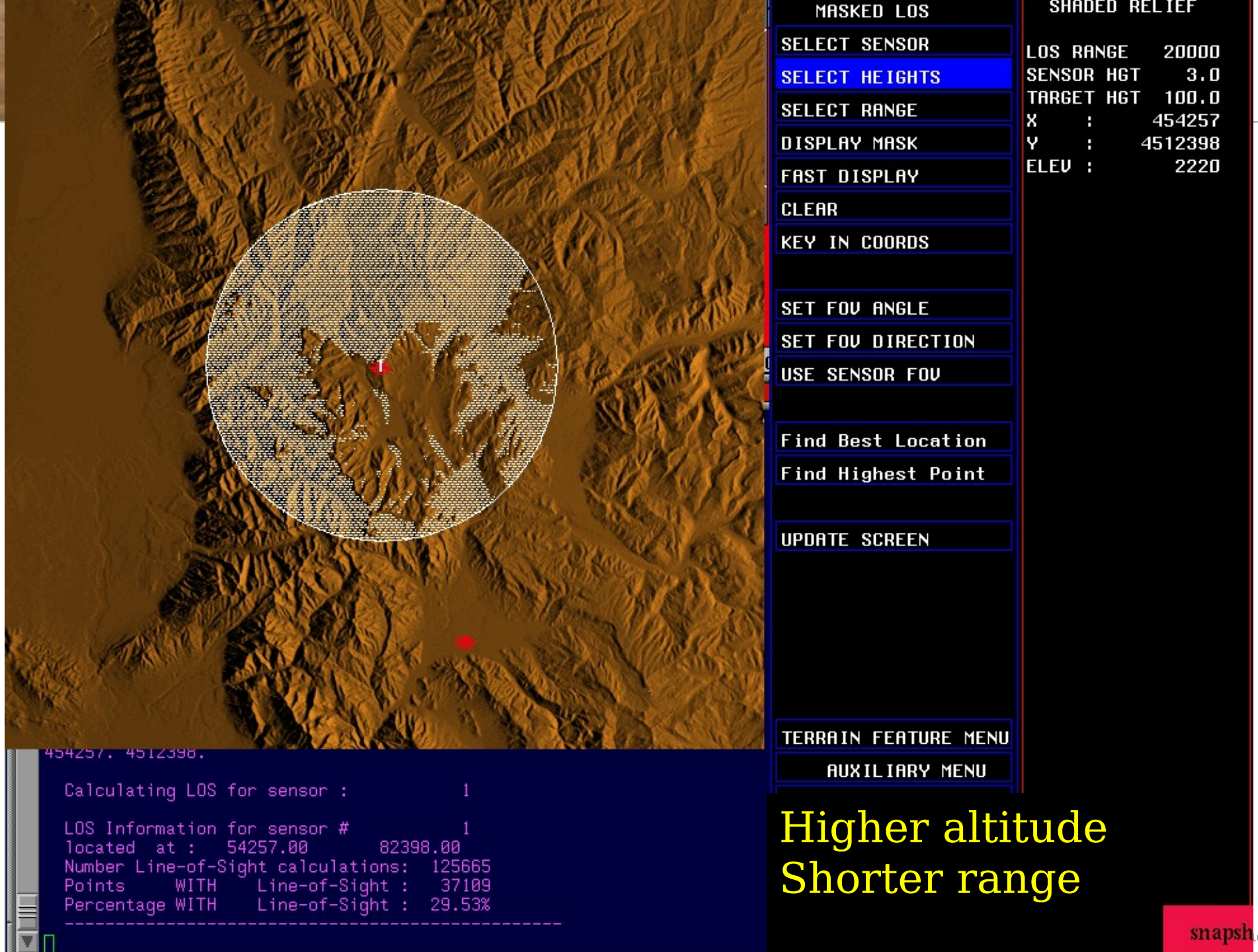
CSC
EXPERIENCE. RESULTS.

Predicted LOS

- Two sensor locations
- Two target altitudes
- Two sensor ranges

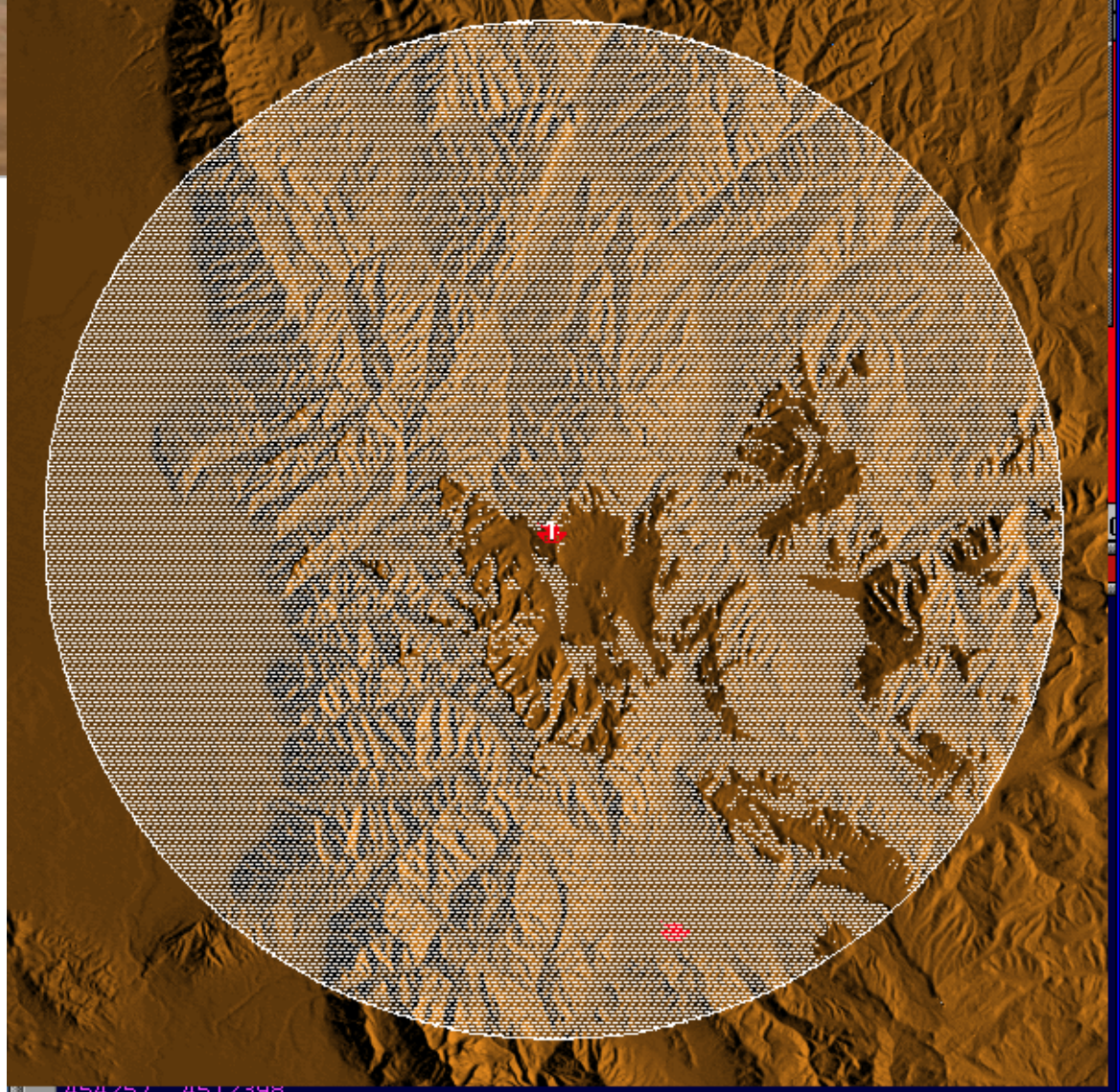


Lower altitude
Shorter range



Higher altitude
Shorter range

snapsh



MASKED LOS

SELECT SENSOR

SELECT HEIGHTS

SELECT RANGE

DISPLAY MASK

FAST DISPLAY

CLEAR

KEY IN COORDS

SET FOV ANGLE

SET FOV DIRECTION

USE SENSOR FOV

Find Best Location

Find Highest Point

UPDATE SCREEN

TERRAIN FEATURE MENU

AUXILIARY MENU

SHADED RELIEF

LOS RANGE	40000
SENSOR HGT	3.0
TARGET HGT	30.0
X :	454257
Y :	4512398
ELEV :	2220

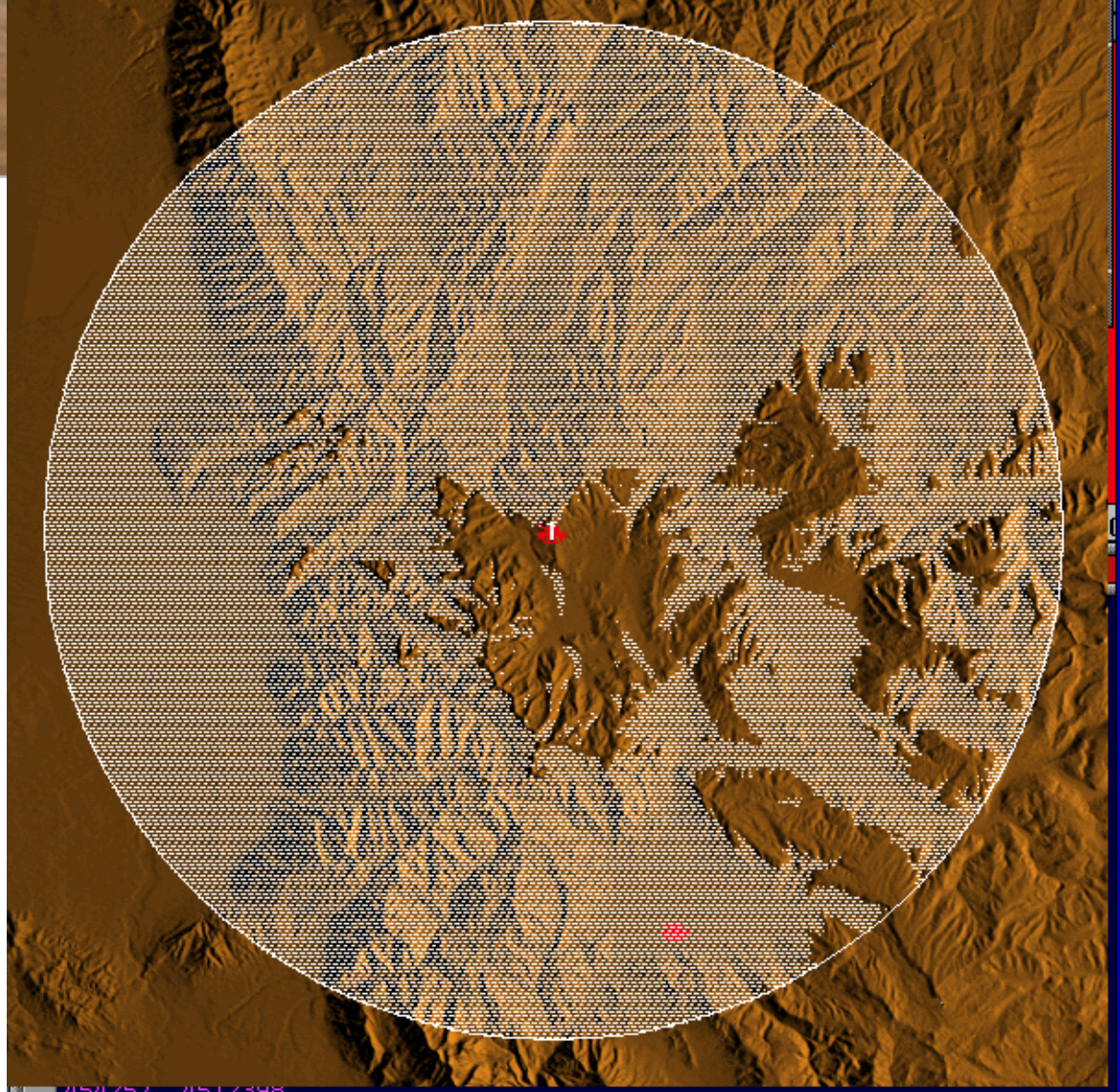
454257. 4512398.

Calculating LOS for sensor : 1

LOS Information for sensor # 1
located at : 54257.00 82398.00
Number Line-of-Sight calculations: 502654
Points WITH Line-of-Sight : 42625
Percentage WITH Line-of-Sight : 8.48%

Lower altitude
Longer range

snapsh



MASKED LOS

SELECT SENSOR

SELECT HEIGHTS

SELECT RANGE

DISPLAY MASK

FAST DISPLAY

CLEAR

KEY IN COORDS

SET FOV ANGLE

SET FOV DIRECTION

USE SENSOR FOV

Find Best Location

Find Highest Point

UPDATE SCREEN

TERRAIN FEATURE MENU

AUXILIARY MENU

SHADED RELIEF

LOS RANGE	40000
SENSOR HGT	3.0
TARGET HGT	100.0
X :	454257
Y :	4512398
ELEV :	2220

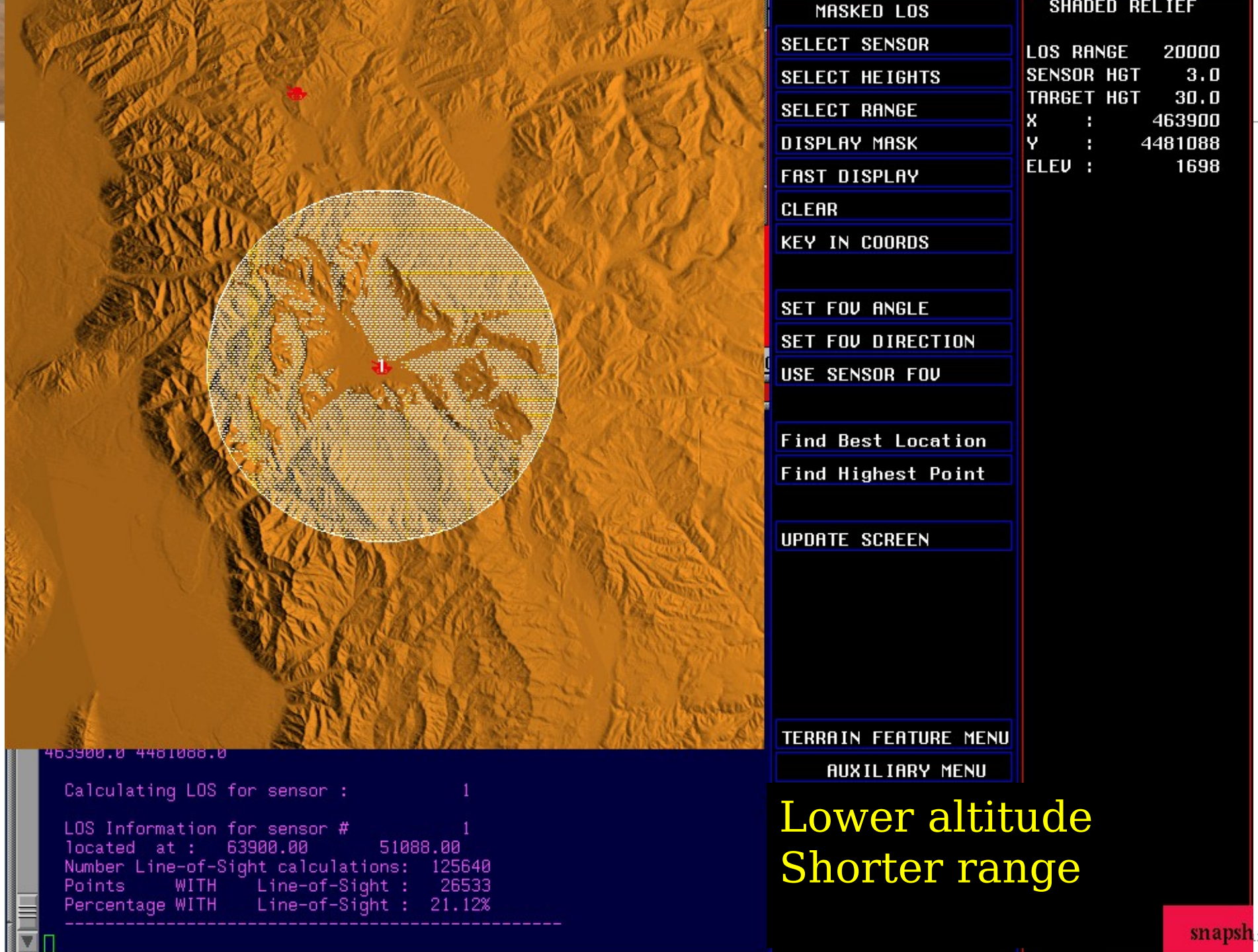
454257. 4512398.

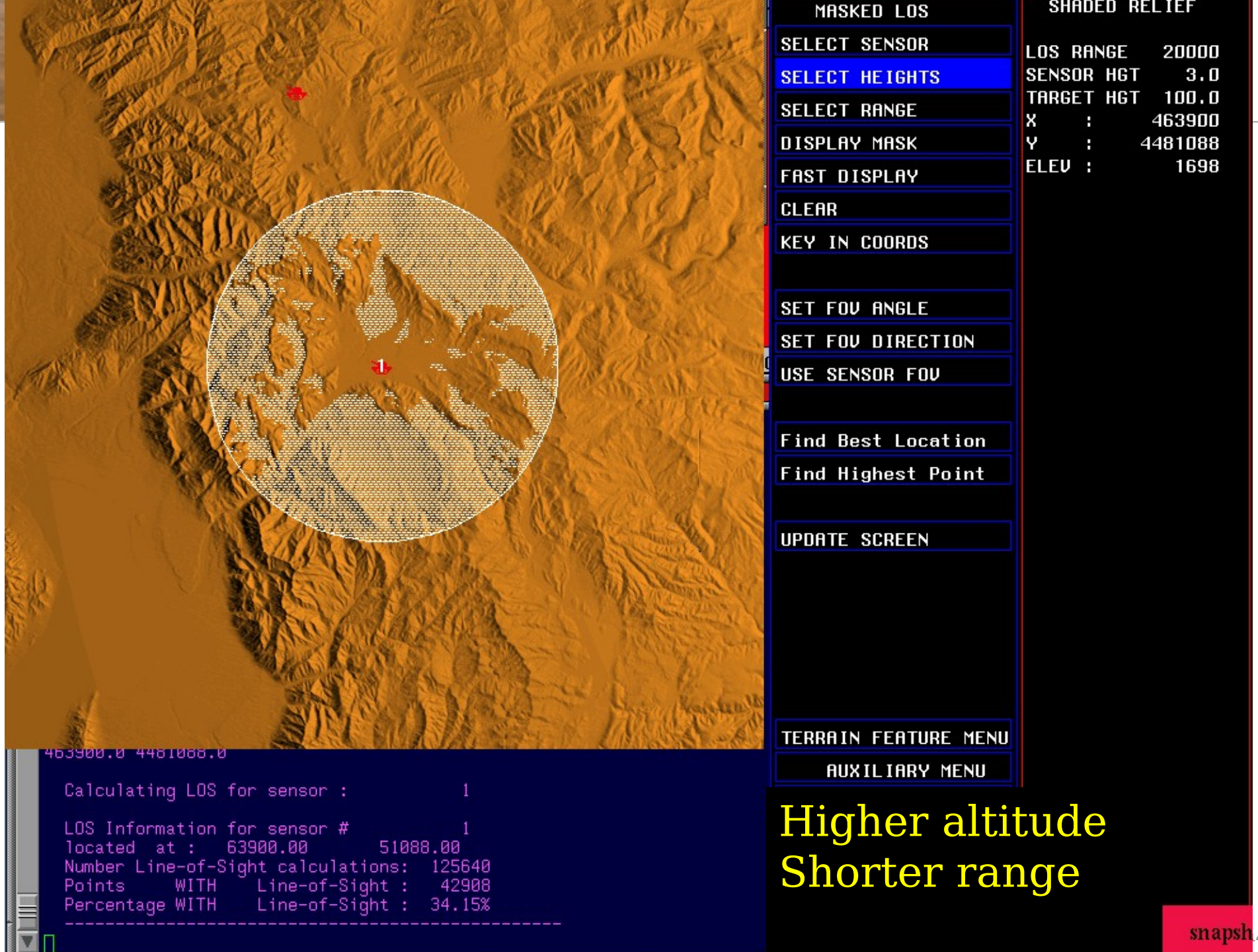
Calculating LOS for sensor : 1

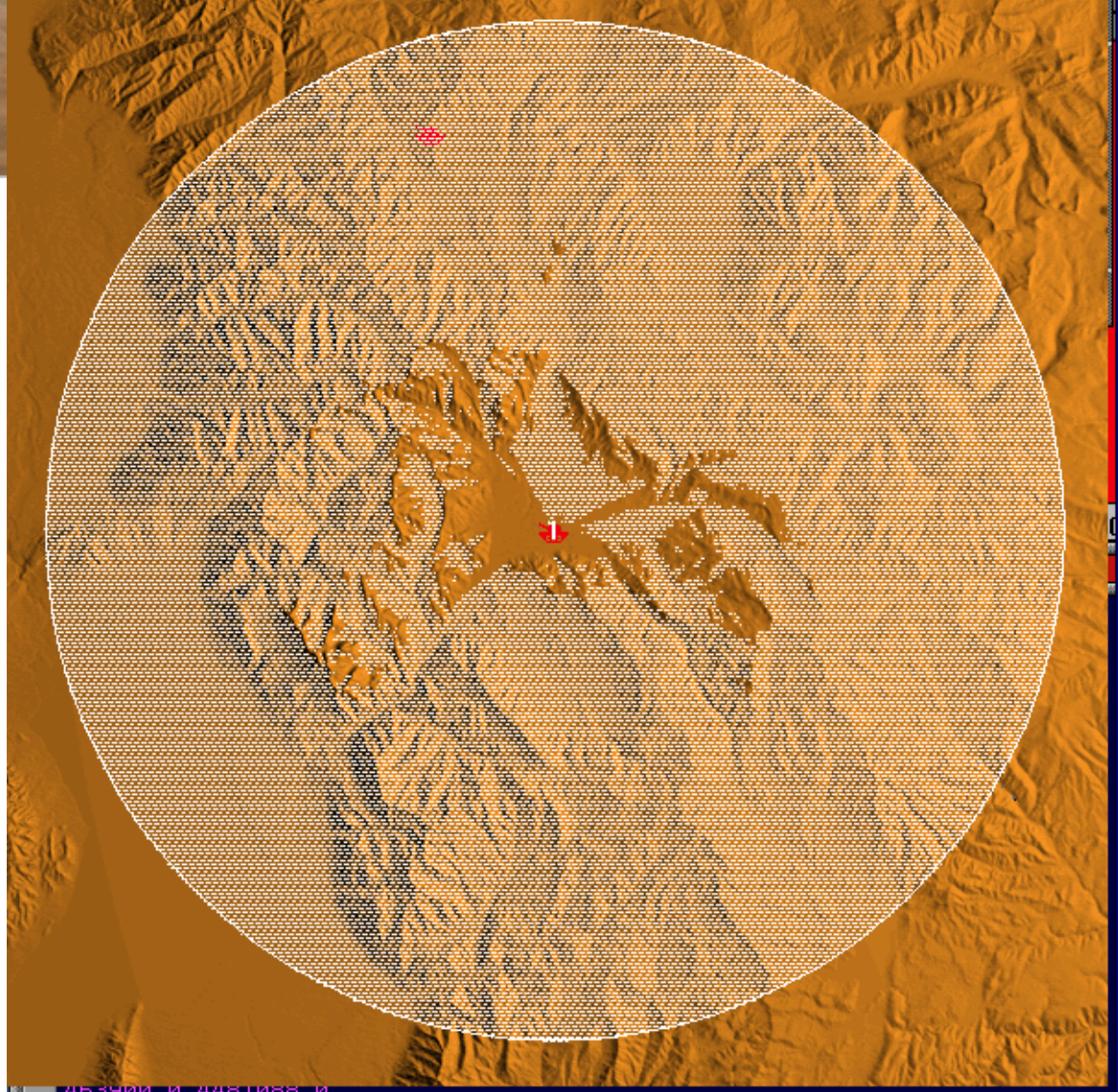
LOS Information for sensor # 1
located at : 54257.00 82398.00
Number Line-of-Sight calculations: 502654
Points WITH Line-of-Sight : 69167
Percentage WITH Line-of-Sight : 13.76%

Higher altitude
Longer range

snapsh


MASKED LOS
SELECT SENSOR
SELECT HEIGHTS
SELECT RANGE
DISPLAY MASK
FAST DISPLAY
CLEAR
KEY IN COORDS
SET FOV ANGLE
SET FOV DIRECTION
USE SENSOR FOV
Find Best Location
Find Highest Point
UPDATE SCREEN
TERRAIN FEATURE MENU
AUXILIARY MENU
SHADED RELIEF
LOS RANGE 20000
SENSOR HGT 3.0
TARGET HGT 30.0
X : 463900
Y : 4481088
ELEV : 1698
463900.0 4481088.0
Calculating LOS for sensor : 1
LOS Information for sensor # 1
located at : 63900.00 51088.00
Number Line-of-Sight calculations: 125640
Points WITH Line-of-Sight : 26533
Percentage WITH Line-of-Sight : 21.12%
Lower altitude
Shorter range


MASKED LOS
SELECT SENSOR
SELECT HEIGHTS
SELECT RANGE
DISPLAY MASK
FAST DISPLAY
CLEAR
KEY IN COORDS
SET FOV ANGLE
SET FOV DIRECTION
USE SENSOR FOV
Find Best Location
Find Highest Point
UPDATE SCREEN
TERRAIN FEATURE MENU
AUXILIARY MENU
SHADED RELIEF
LOS RANGE 20000
SENSOR HGT 3.0
TARGET HGT 100.0
X : 463900
Y : 4481088
ELEV : 1698
463900.0 4481088.0
Calculating LOS for sensor : 1
LOS Information for sensor # 1
located at : 63900.00 51088.00
Number Line-of-Sight calculations: 125640
Points WITH Line-of-Sight : 42908
Percentage WITH Line-of-Sight : 34.15%
Higher altitude
Shorter range



MASKED LOS

SELECT SENSOR

SELECT HEIGHTS

SELECT RANGE

DISPLAY MASK

FAST DISPLAY

CLEAR

KEY IN COORDS

SET FOV ANGLE

SET FOV DIRECTION

USE SENSOR FOV

Find Best Location

Find Highest Point

UPDATE SCREEN

TERRAIN FEATURE MENU

AUXILIARY MENU

SHADED RELIEF

LOS RANGE	40000
SENSOR HGT	3.0
TARGET HGT	30.0
X :	463900
Y :	4481088
ELEV :	1698

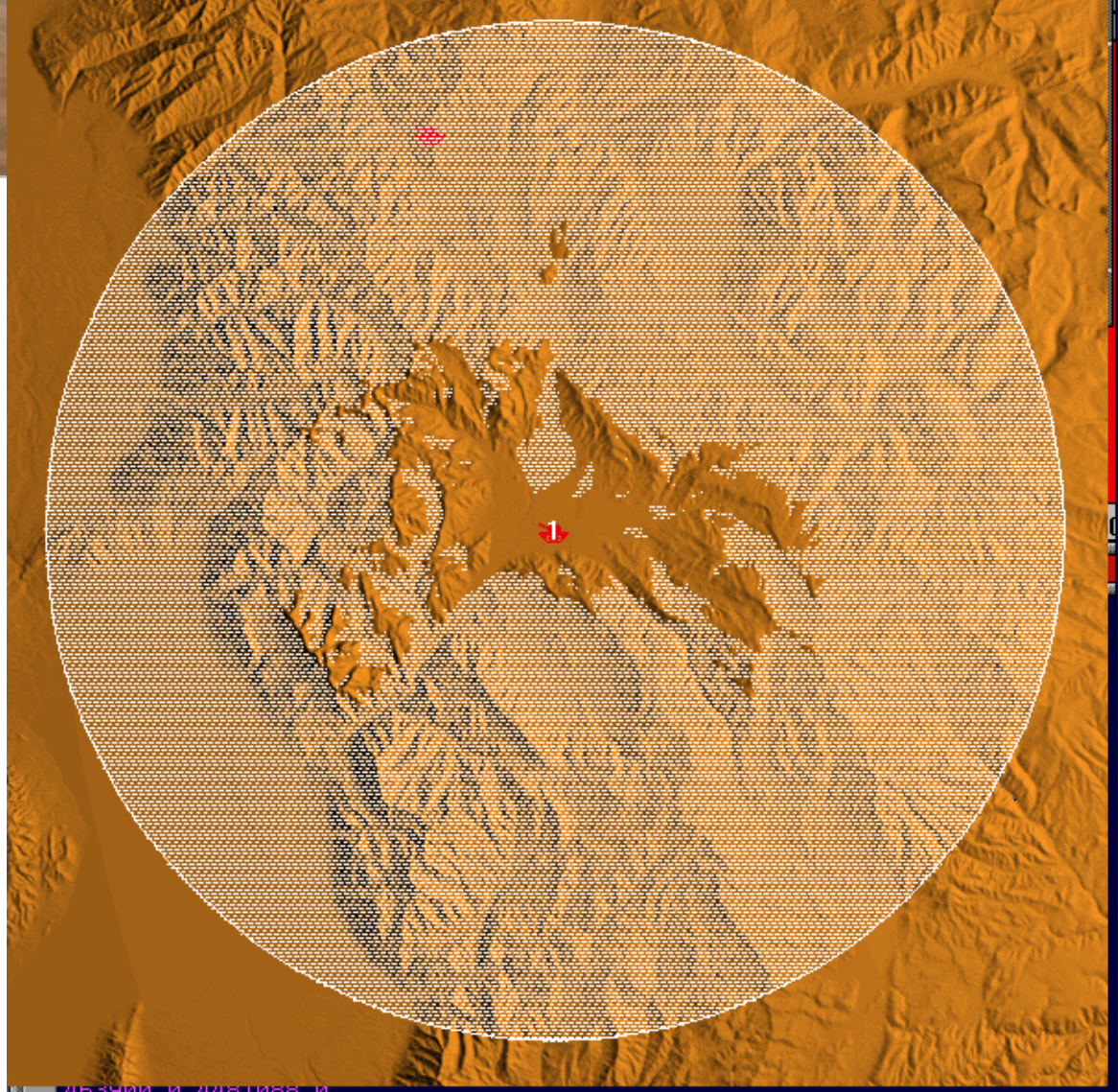
463900.0 4481088.0

Calculating LOS for sensor : 1

LOS Information for sensor # 1
located at : 63900.00 51088.00
Number Line-of-Sight calculations: 502634
Points WITH Line-of-Sight : 27291
Percentage WITH Line-of-Sight : 5.43%

Low altitude
Longer range

snapsh



MASKED LOS

SELECT SENSOR

SELECT HEIGHTS

SELECT RANGE

DISPLAY MASK

FAST DISPLAY

CLEAR

KEY IN COORDS

SET FOV ANGLE

SET FOV DIRECTION

USE SENSOR FOV

Find Best Location

Find Highest Point

UPDATE SCREEN

TERRAIN FEATURE MENU

AUXILIARY MENU

SHADED RELIEF

LOS RANGE	40000
SENSOR HGT	3.0
TARGET HGT	100.0
X :	463900
Y :	4481088
ELEV :	1698

463900.0 4481088.0

Calculating LOS for sensor : 1

LOS Information for sensor # 1
located at : 63900.00 51088.00
Number Line-of-Sight calculations: 502634
Points WITH Line-of-Sight : 44716
Percentage WITH Line-of-Sight : 8.90%

Higher altitude
Longer range

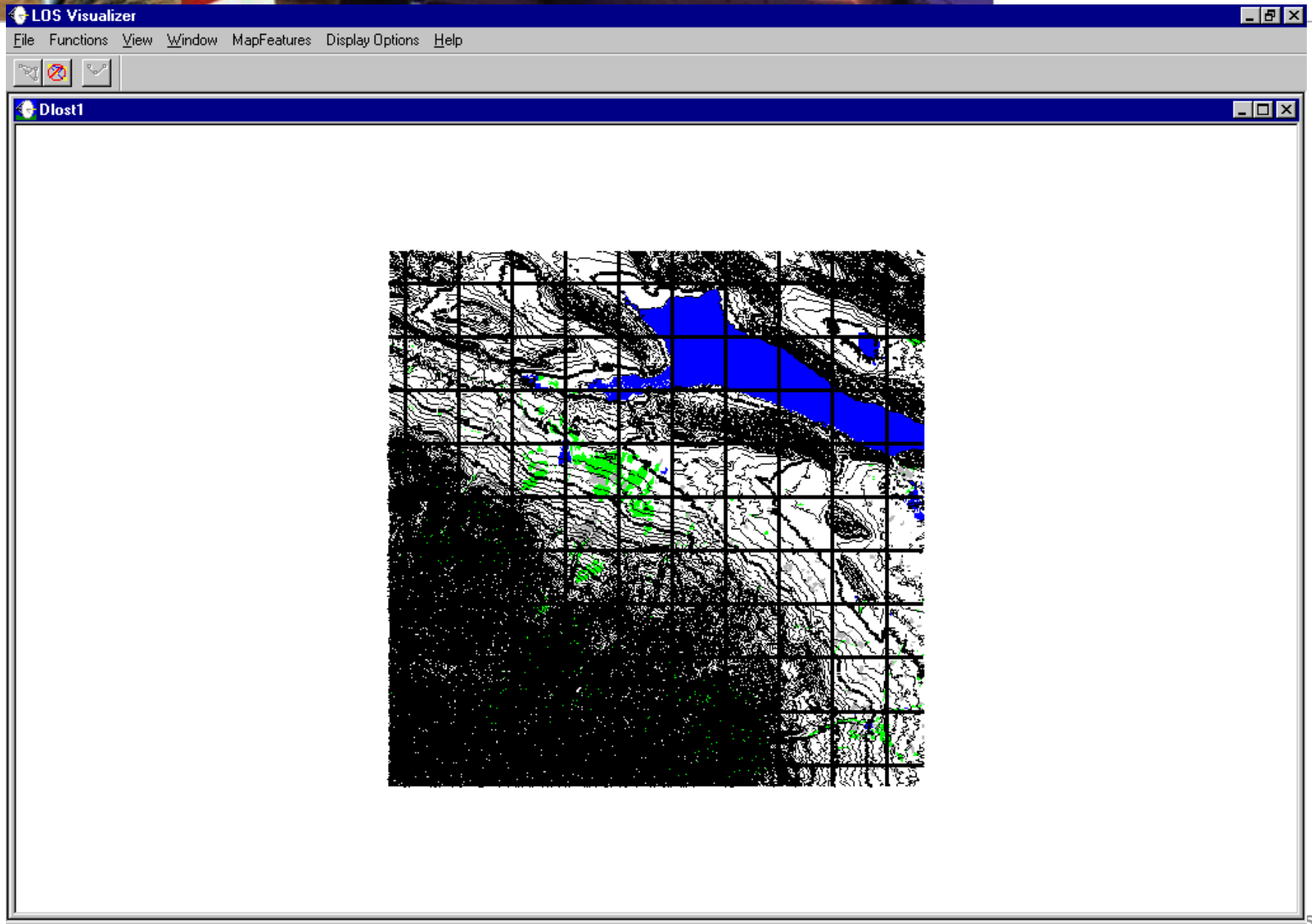
snapsh

Distributed LOS Tool DLOST

CSC
EXPERIENCE. RESULTS.

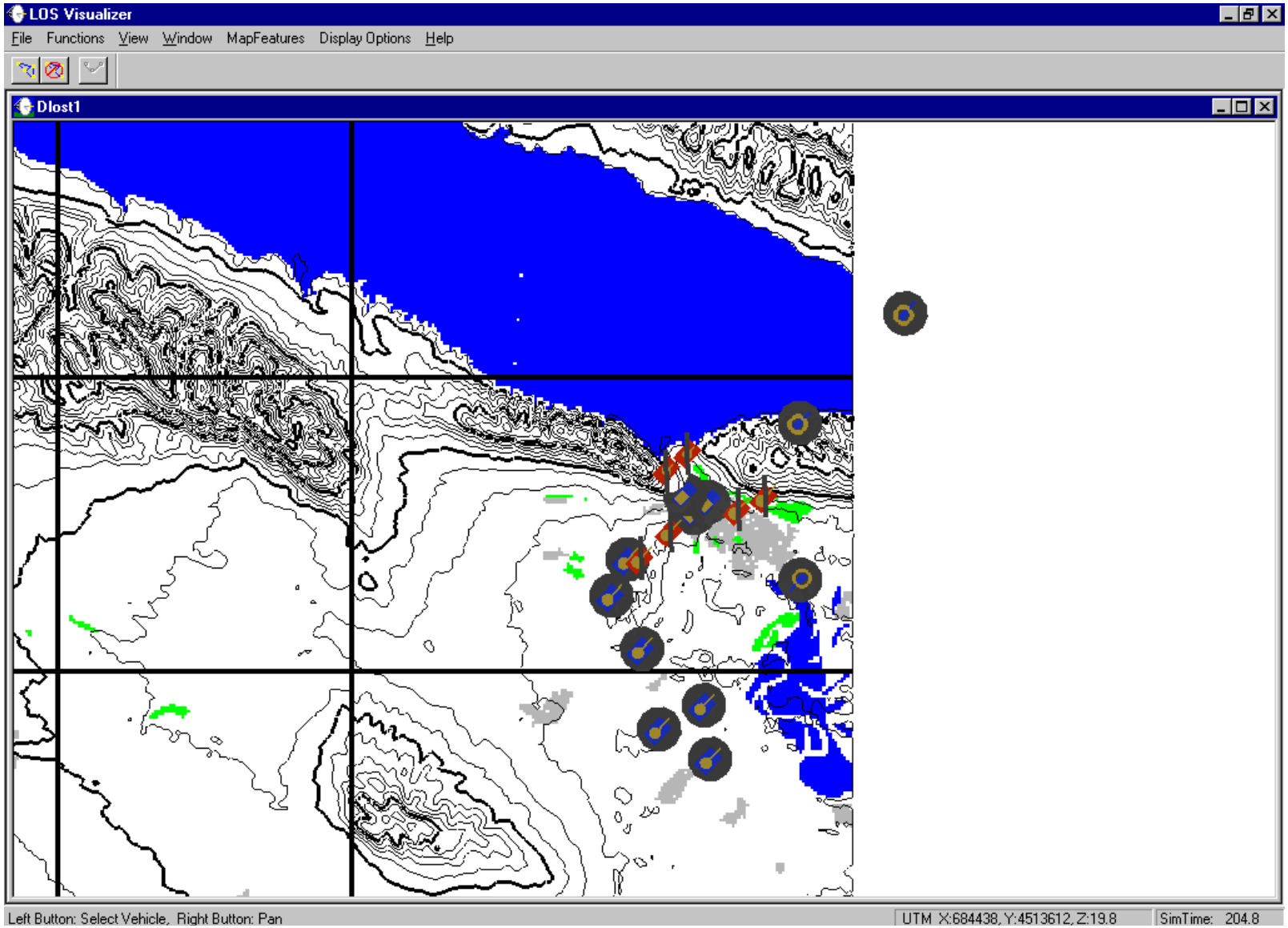
- Tool used to check LOS between entities for communication during distributed exercises
- LOS required to allow vehicle receive netcentric information (situational awareness)
- Geometric LOS algorithm
- Terrain database correlated to terrain databases used in the distributed exercise

DLOST Map Display



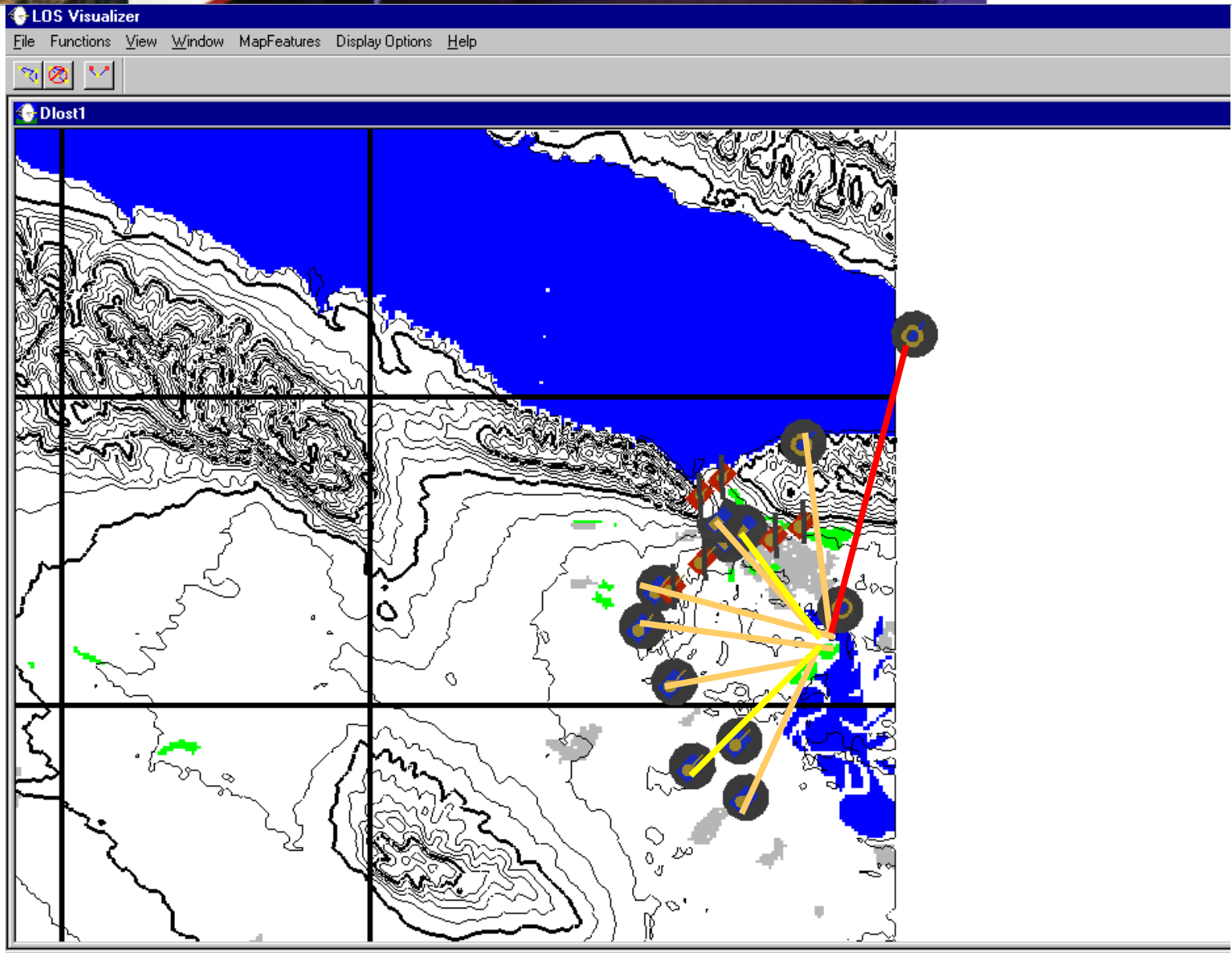
DLOST Entity Map Display

CSC
EXPERIENCE. RESULTS.


LOS Visualizer
File Functions View Window MapFeatures Display Options Help
Dlost1
Left Button: Select Vehicle, Right Button: Pan
UTM X:684438, Y:4513612, Z:19.8
SimTime: 204.8

DLOST Entities LOS Display

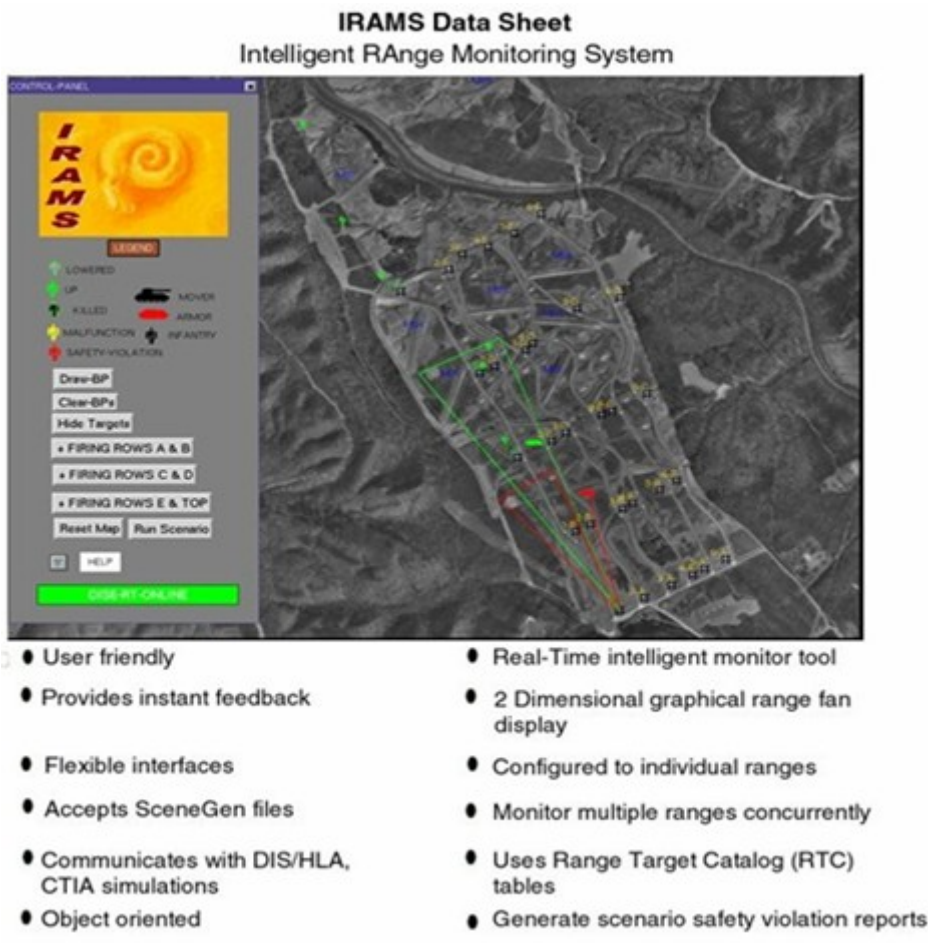
CSC
EXPERIENCE. RESULTS.


LOS Visualizer
File Functions View Window MapFeatures Display Options Help
Dlost1
Marking: < 1150009 >, Location: 674286 4518490 716.1 meters, Speed: 39.1 m/s, DIS ID: 15:4:9 < 0 >
UTM X:663227, Y:4502815, Z:111.1

Intelligent Range Monitoring Sys. (IRAM

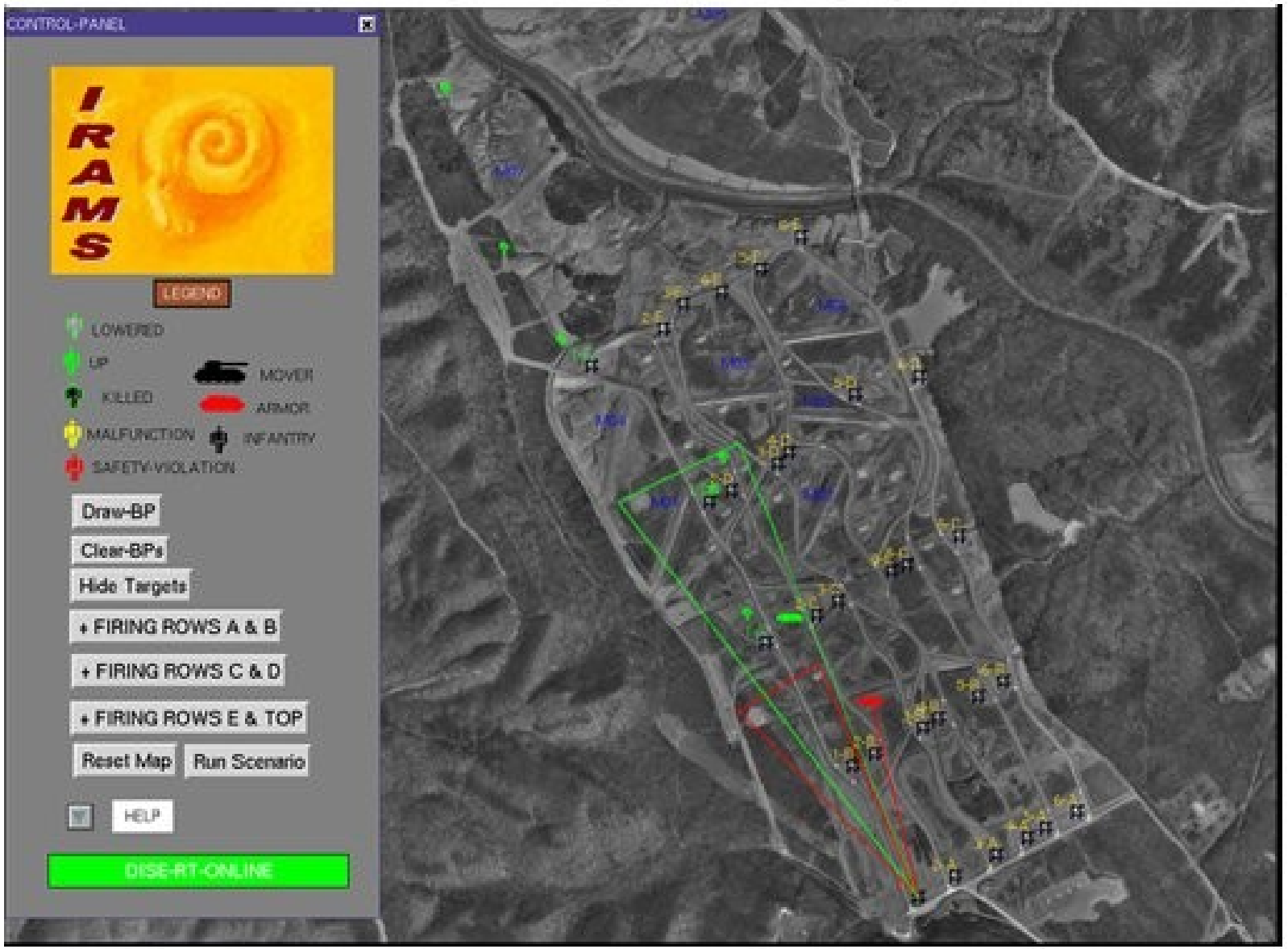
EXPERIENCE. RESULTS.

- **IRAMS is deployed on laptops for range safety officers and trainers.**
- **IRAMS is a prototype tool to assist range safety officers in determining range safety perimeters.**
- **Part of an integrated software suite of tools to provide the range safety officer with an automated means to quickly determine the safety on the ranges and surrounding areas.**
- **Trainer builds the training scenario and determines which firing points and targets pairings are acceptable prior to the submission to the Range Safety Officer for approval.**



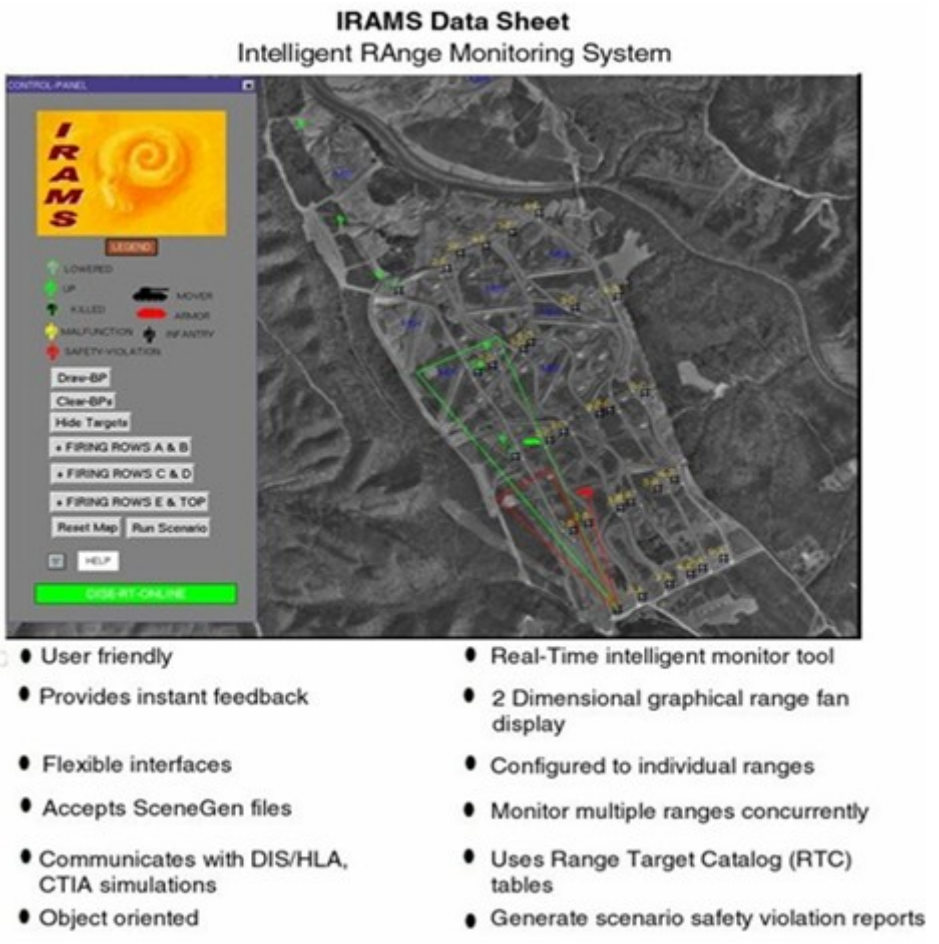
Intelligent Range Monitoring System (IRAMS)

CSC
EXPERIENCE. RESULTS.



Intelligent Range Monitoring System (IRAMS)

- **Add digital terrain and LOS coverage fan capability to IRAMS**
- **Drape Satellite imagery over digital terrain**
- **Allow the range personnel to update the digital terrain with current and seasonal information**
- **Provide a prototype / testbed for incorporating and updating digital terrain for battlefield support**



Proto-Command

CSC
EXPERIENCE. RESULTS.

- **Proto-command - Integration and Synchronization Tool:**
  - **Integrates Disparate Simulation Protocols**
  - **Fuses Information to a Common View**
  - **Uses AI to Facilitate Decisions**
- **Proto-command Provides:**
  - **Emulation of the Common Operating Picture**
  - **Displays Picture of Relevant Information Tailored to Critical Information at Each Command Level**
  - **Keystone of Situational Awareness**
    - **Provides Commanders With Information on a Map GUI**
    - **Commanders Can Focus on a Target by Zooming Into the Icon or Area**
  - **Gives Commanders the Full Spectrum of Combat Capabilities - Quickly Prepare, Detect, Decide, Engage and Assess Situation**
  - **From Initial Sensing to BDA, Protocommand Provides the Solution**

M&S Center of excellence

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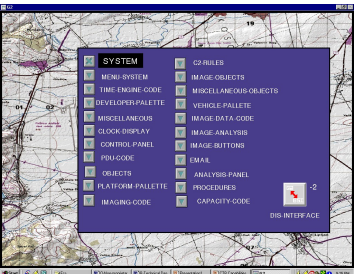
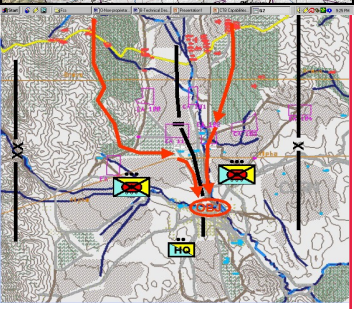
EXPERIENCE. RESULTS.

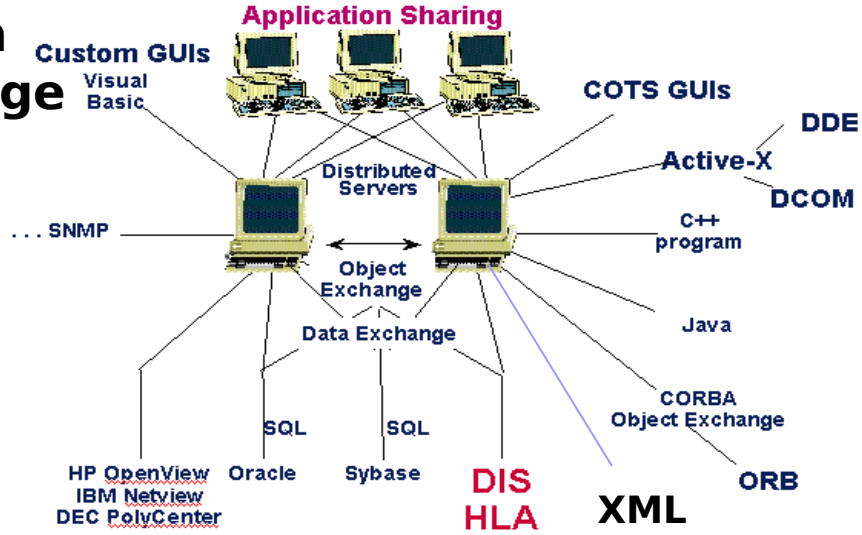
Proto-Command Key Capabilities

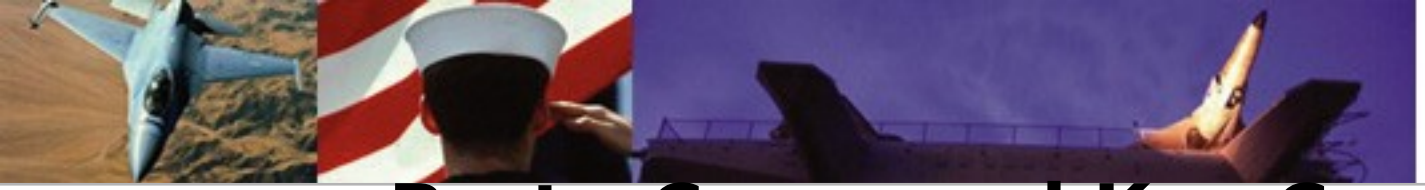




The force-on-force models with entity level granularity can provide a proving ground for intelligent net-centric command and control functions

- **Flexible proving ground for integrating and evaluating intelligent command and control functions**
  - **Interfaces with Distributed simulations**
- **Advanced knowledge capture and reasoning**
  - **Rules, procedures, neural nets, fuzzy logic, and intelligent agents**
- **DIS/HLA interface, platform-level monitoring**
- **Open communication through data-exchange standards**
- **Decision Support**
- **Client-server**
- **Peer to peer**
- **C3 grid**





EXPERIENCE. RESULTS.

Proto-Command Key Capabilities (Cont'd)

Domain Experts (Warfighters) rule sets can be applied for intelligent decision support

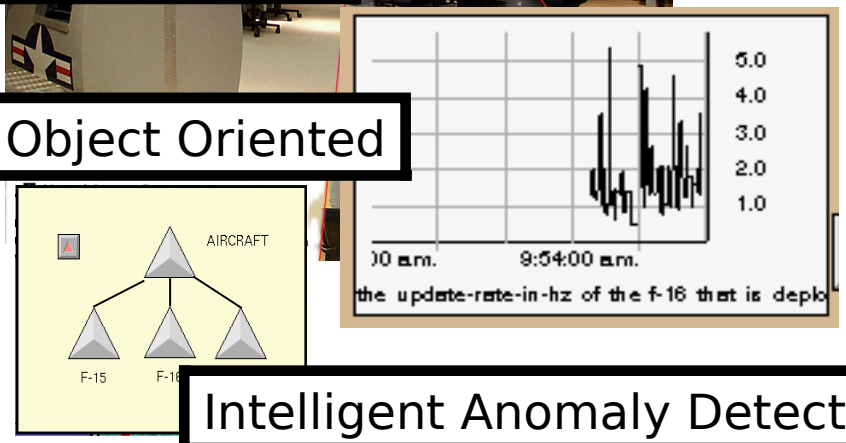
- **Real-time Inference Engine**
- **Improves ability of humans to handle information and convert volumes of data into knowledge**
- **Reconcile conflicting data**
- **Natural language allows domain experts to write and understand rules**
- **Graphic and Object architecture provides significant prototyping capability**

Rule based

f the inner stripe-color of the atm-connection connected to eglin-afb is green then conclude that the site-status of eglin-mtc = "On-Line"

Natural Language

Object Oriented



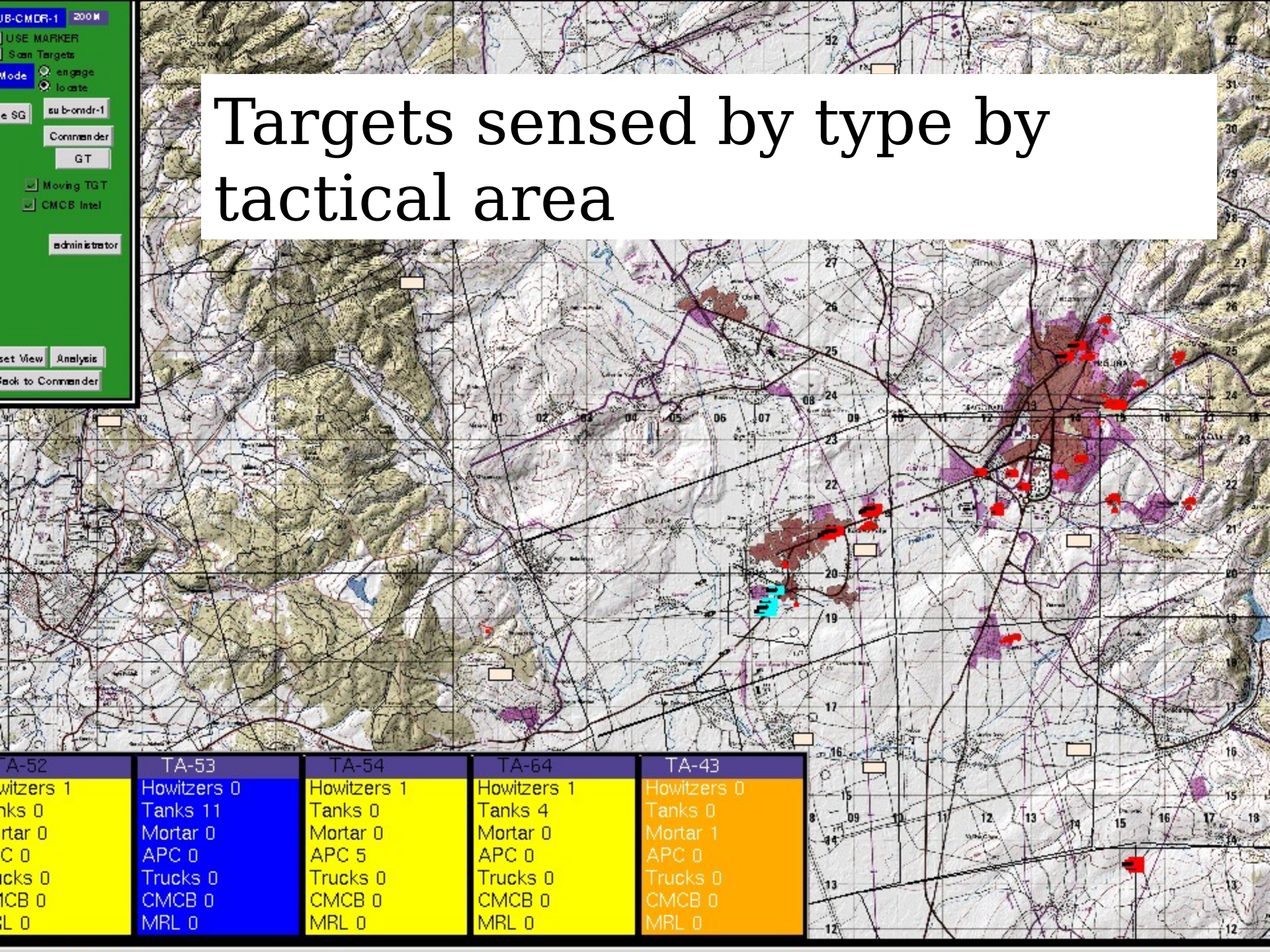
Intelligent Anomaly Detectio

CSC
EXPERIENCE. RESULTS.

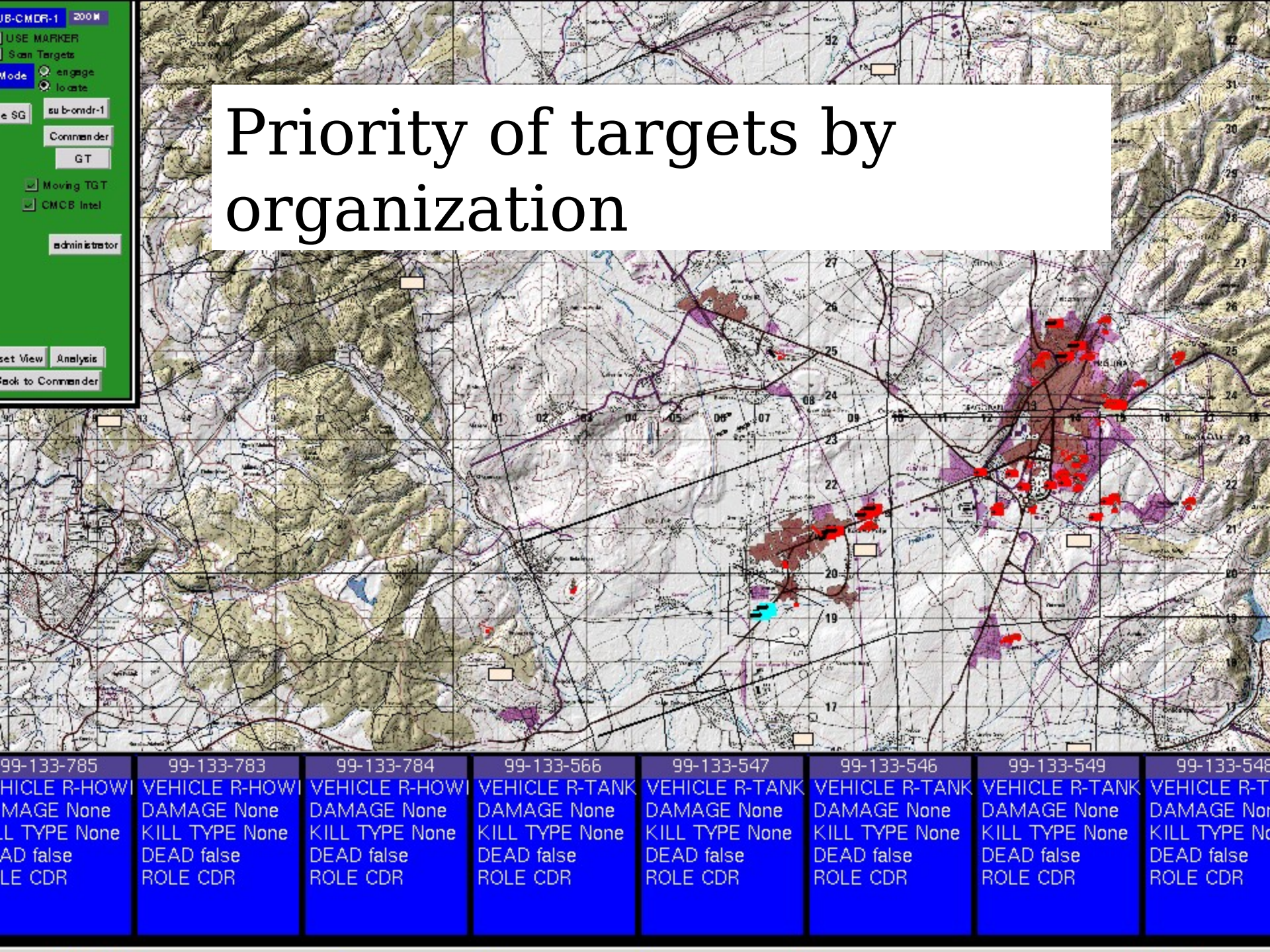
Proposed LOS and Terrain Enhancements

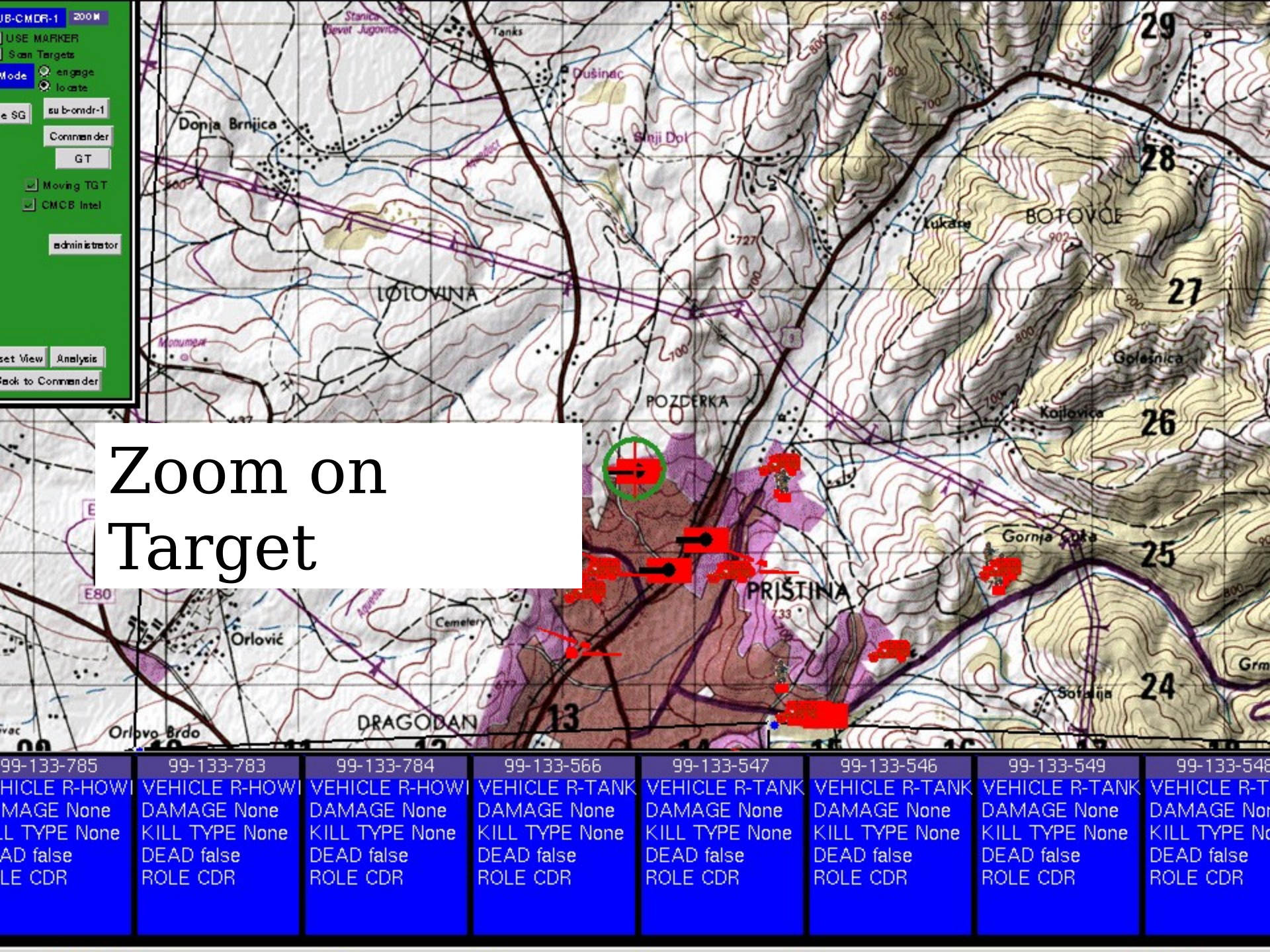
- Propose adding LOS checks to vehicles to aid in vehicle positioning
- Propose updating terrain and LOS databases from individual vehicles or sensors observations
- Aids situational awareness
- Radio LOS to other vehicles (including UAVs) to be netcentric

Targets sensed by type by tactical area



Priority of targets by organization




UB-CMDR-1
200 M
USE MARKER
Scan Targets
Mode
engage
locate
sub-cmdr-1
Commander
GT
Moving TGT
CMCB Intel
administrator
set View
Analysis
Back to Commander
Zoom on Target
Donja Brnjica
Tanks
Dušinac
Sinji Dol
LOLOVINA
POZDERKA
BOTOVCE
Kukare
Golesnica
Kojlovica
Gornja Kuta
PRIŠTINA
Cemetery
Orlović
Orlovo Brdo
DRAGODAN
Sofalija
E80
99-133-785
HICLE R-HOWI
MAGE None
L TYPE None
AD false
LE CDR
99-133-783
VEHICLE R-HOWI
DAMAGE None
KILL TYPE None
DEAD false
ROLE CDR
99-133-784
VEHICLE R-HOWI
DAMAGE None
KILL TYPE None
DEAD false
ROLE CDR
99-133-566
VEHICLE R-TANK
DAMAGE None
KILL TYPE None
DEAD false
ROLE CDR
99-133-547
VEHICLE R-TANK
DAMAGE None
KILL TYPE None
DEAD false
ROLE CDR
99-133-546
VEHICLE R-TANK
DAMAGE None
KILL TYPE None
DEAD false
ROLE CDR
99-133-549
VEHICLE R-TANK
DAMAGE None
KILL TYPE None
DEAD false
ROLE CDR
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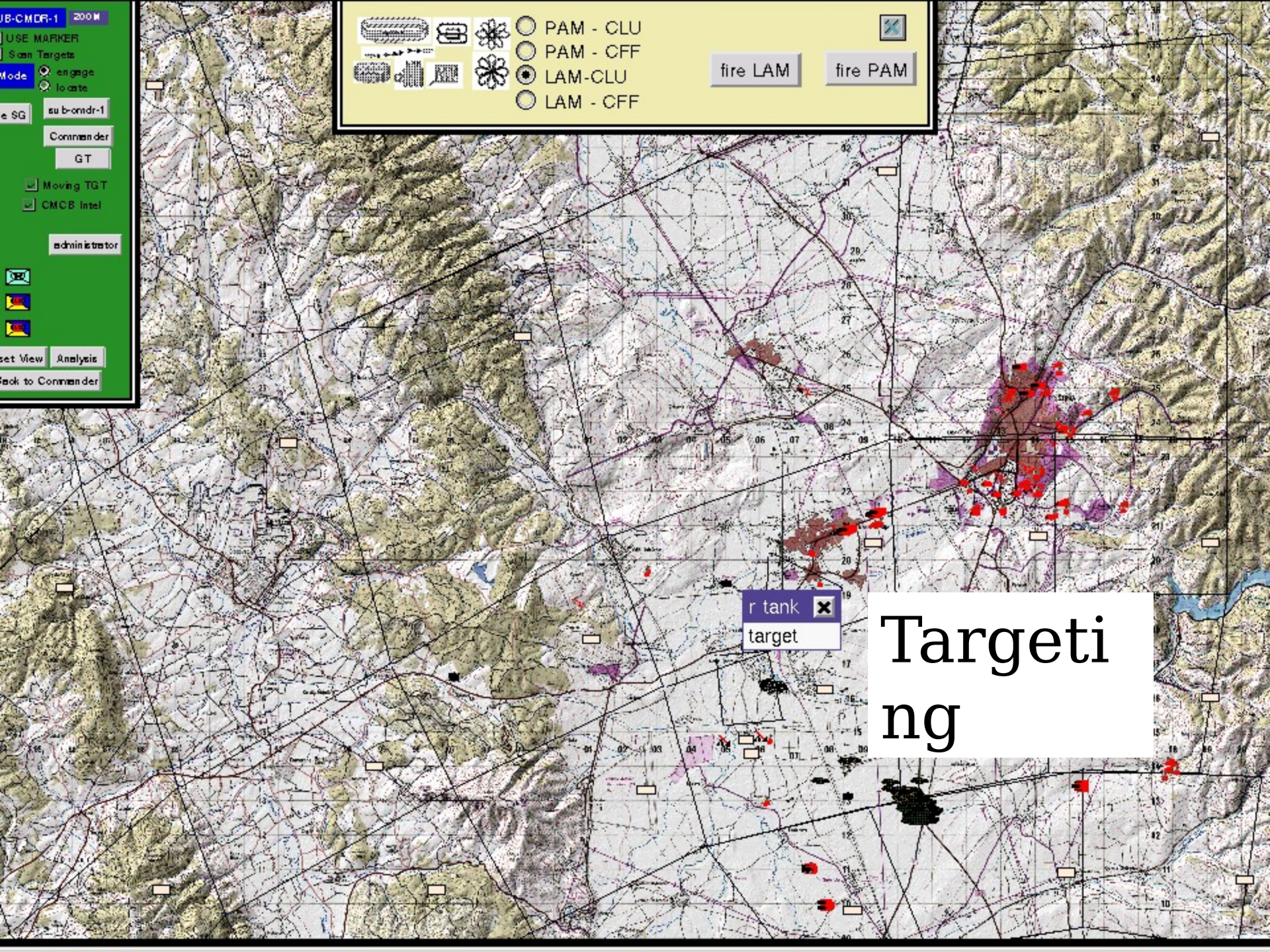
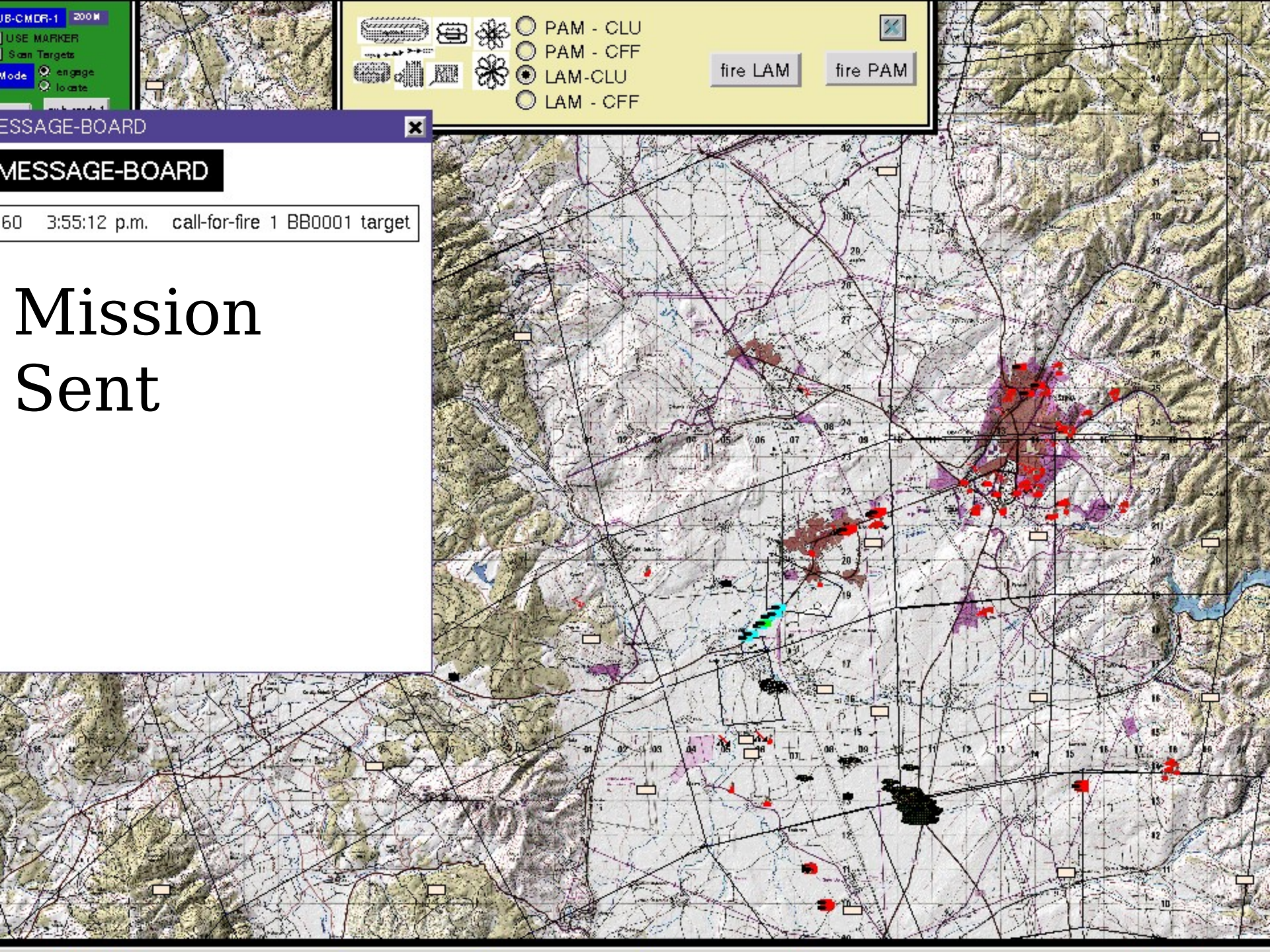
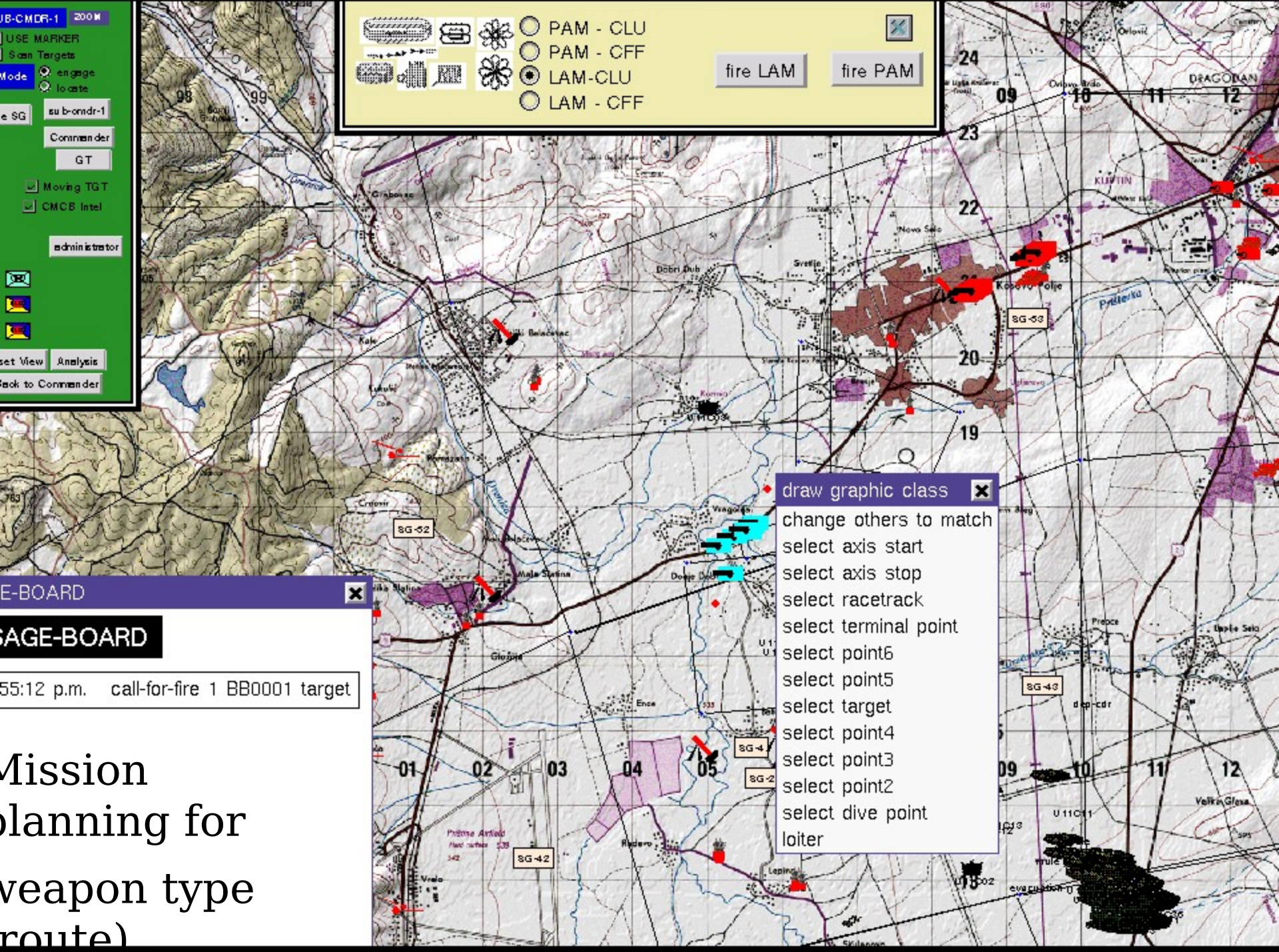
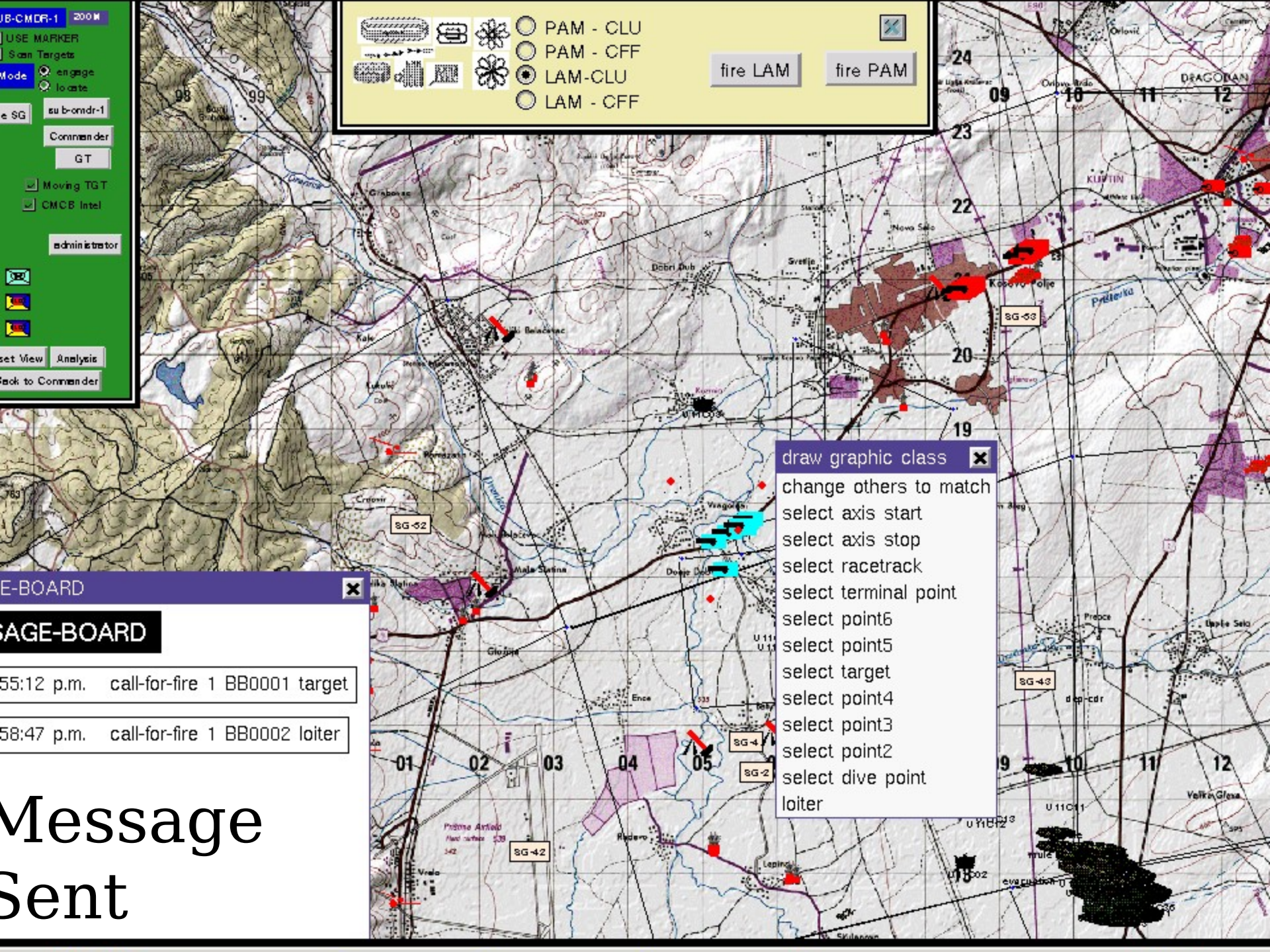
VEHICLE R-T
DAMAGE No
KILL TYPE No
DEAD false
ROLE CDR


UB-CMDR-1
200 M
USE MARKER
Scan Targets
Mode
engage
locate
e SG
sub-cmdr-1
Commander
GT
Moving TGT
CMCB Intel
administrator
set View
Analysis
Back to Commander
PAM - CLU
PAM - CFF
LAM-CLU
LAM - CFF
fire LAM
fire PAM
r tank
target
Targeti
ng


USE MARKER
Scan Targets
Mode
engage
locate
PAM - CLU
PAM - CFF
LAM-CLU
LAM - CFF
fire LAM
fire PAM
ESSAGE-BOARD
MESSAGE-BOARD
60 3:55:12 p.m. call-for-fire 1 BB0001 target
Mission
Sent



Mission
planning for
weapon type
route)


USE MARKER
Scan Targets
engage
locate
sub-cmdr-1
Commander
GT
Moving TGT
CMCB Intel
administrator
Analysis
PAM - CLU
PAM - CFF
LAM-CLU
LAM - CFF
fire LAM
fire PAM
draw graphic class
change others to match
select axis start
select axis stop
select racetrack
select terminal point
select point6
select point5
select target
select point4
select point3
select point2
select dive point
loiter
SAGE-BOARD
55:12 p.m. call-for-fire 1 BB0001 target
58:47 p.m. call-for-fire 1 BB0002 loiter
Message
Sent

EXPERIENCE. RESULTS.

LOS Algorithm

- Visibility associated with feature at observer
- Checks LOS at each edge with interpolation of two points for elevation
- Uses feature associated with grid points equal to grid size (square) about the grid point

Intelligent Range Monitoring Sys. (IRAM

EXPERIENCE. RESULTS.

IRAMS is a prototype tool to assist range safety officers in determining range safety perimeters. MSCoE foresees the utility of creating an integrated software suite of tools to provide the range safety officer with an automated means to quickly determine the safety on the ranges and surrounding areas.

The U.S. Army has 300+ ranges in the United States alone and many more ranges throughout the world. Every range's primary concern is safety. Among these safety concerns is the Surface

IRAMS Data Sheet

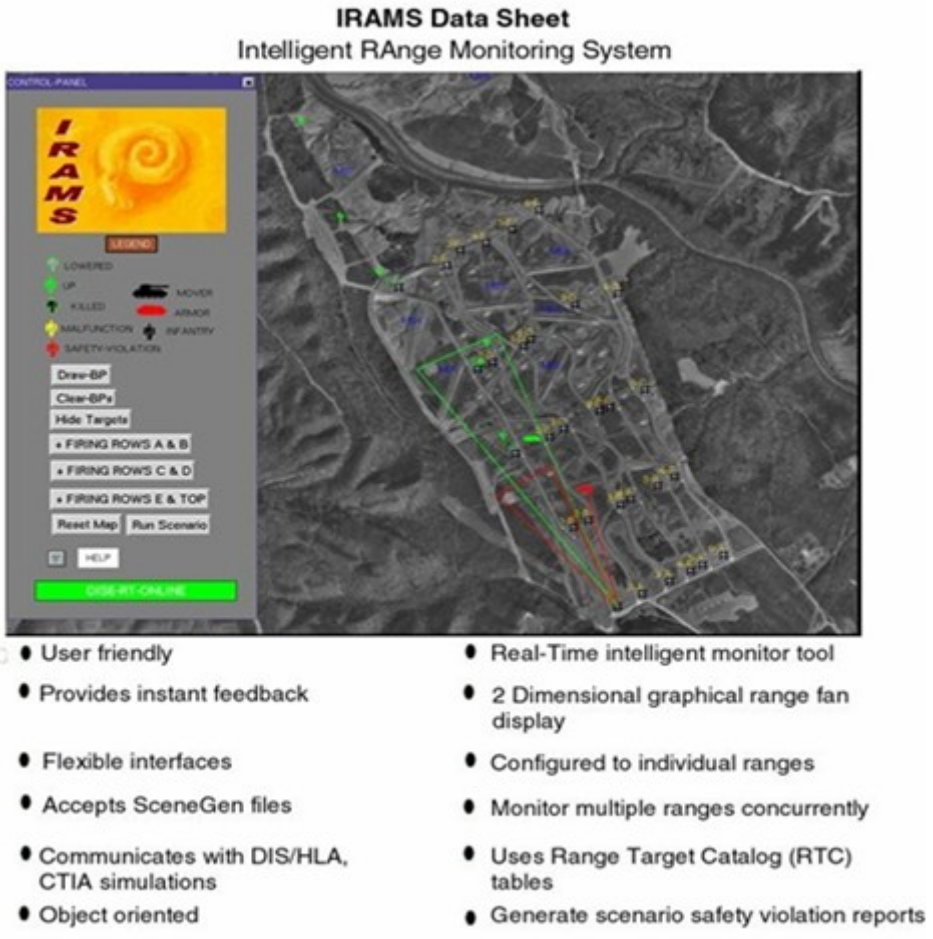
Intelligent RAnge Monitoring System

- User friendly
- Provides instant feedback
- Flexible interfaces
- Accepts SceneGen files
- Communicates with DIS/HLA, CTIA simulations
- Object oriented
- Real-Time intelligent monitor tool
- 2 Dimensional graphical range fan display
- Configured to individual ranges
- Monitor multiple ranges concurrently
- Uses Range Target Catalog (RTC) tables
- Generate scenario safety violation reports

Intelligent Range Monitoring System (I

EXPERIENCE. RESULTS.

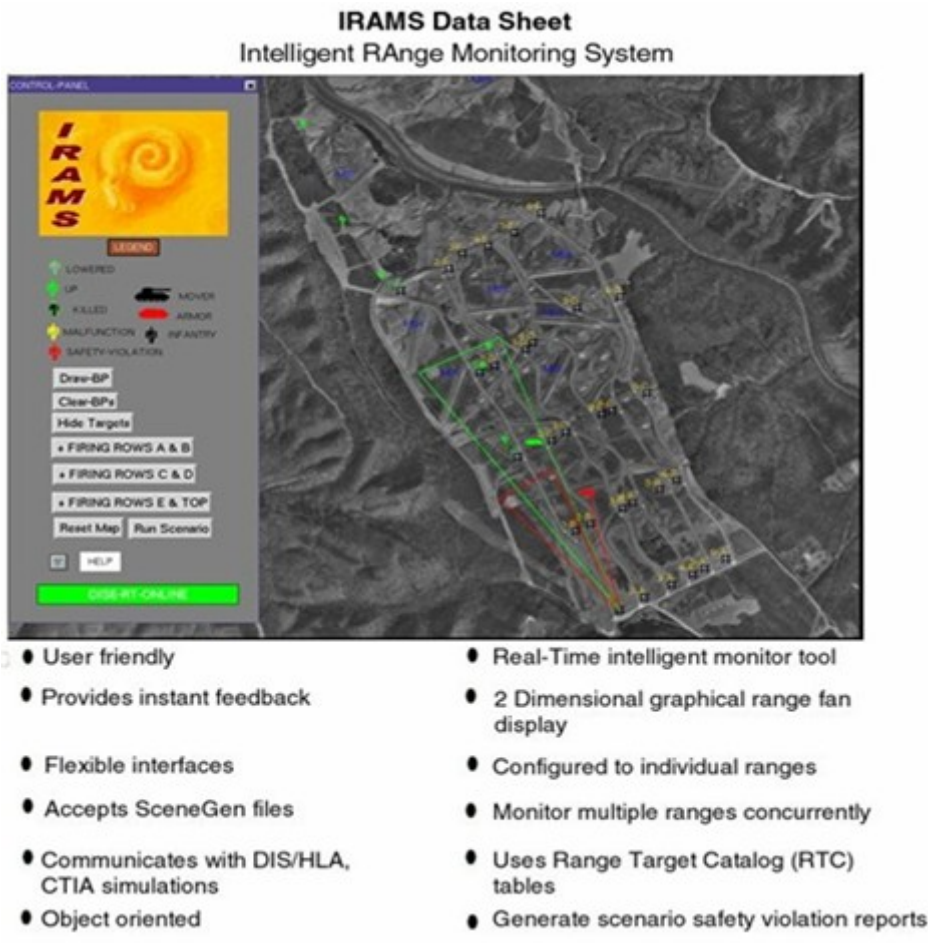
The Intelligent RAnge Monitoring System / (IRAMS) tool suite has been developed by CSC using the Gensym G2-based application. The IRAMS Scenario Verification Tool (ISVT) is the first tool in the development of the IRAMS suite. It will determine SDZs for range safety verification during the process of developing scenarios. The first release of the tool set will allow a Master Gunner/trainer to build the training scenario and determine that the firing points and targets pairings are acceptable prior to the submission to the Range Safety officer for



Intelligent Range Monitoring System (IRA

EXPERIENCE. RESULTS.

The ISVT shown allows the user to select the munitions type, the firing point for the weapon, and desired target location. Once the choices are made, the ISVT performs the surface danger zone calculations and overlays the calculated dispersion fan onto a map of the actual range terrain. For ranges with fixed boundaries, the ISVT determines whether or not there is a safety violation with the Munitions/Firing Point/Target combination. If so, the dispersion fan will be drawn, outlined in Red and text notification provided to the user. When



EXPERIENCE. RESULTS.

Intelligent Range Monitoring System (IRAMS)

- Propose adding LOS checks to range tool
- Propose updating terrain and LOS databases from range observations
- Developmental Environment and Testbed for Tactical Command Tools

EXPERIENCE. RESULTS.

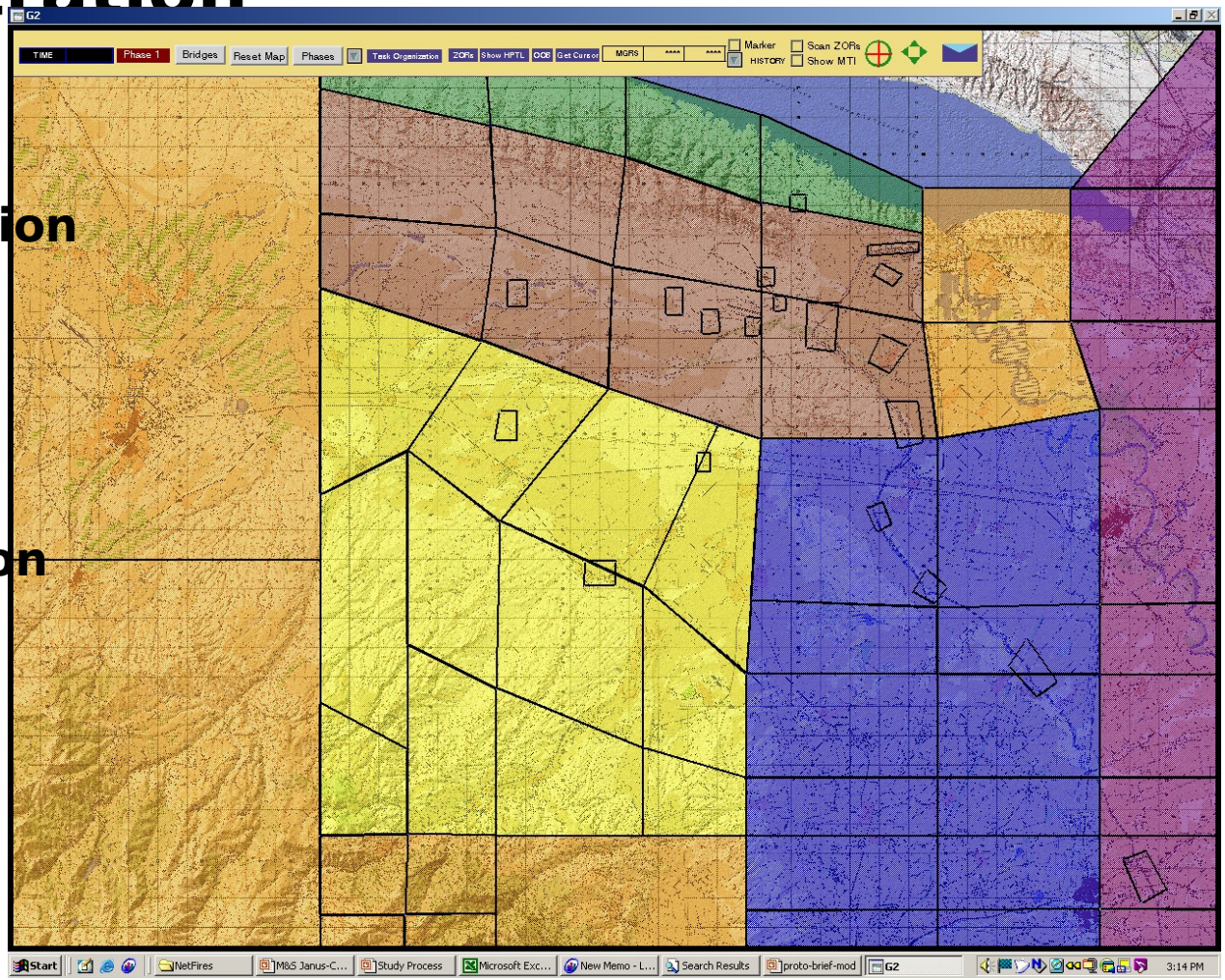
Core Functionality Demonstration

Dynamic Ammo Allocation

Dynamic Prioritization of targets

ATGM Decision Logic

Dynamic Distribution of Fires



PROTO-COMMAND MAP AND VEHICLES

CSC
EXPERIENCE. RESULTS.